

DATA INACCURACY IN THE
GLOBAL TRANSPORTATION NETWORK

Graduate Research Project

David M. Young, Major, USAF

AFIT/GMO/LAL/96N-16

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GLOBAL TRANSPORTATION NETWORK

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David M. Young

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Abstract

Desert Shield/Storm refocused the need for the Department of Defense to develop an effective Total Asset Visibility (TAV) plan. As part of that plan, USTRANSCOM was given the responsibility for the in-transit visibility (ITV) portion. To meet the goal of ITV, USTRANSCOM has developed the Global Transportation Network (GTN).

The GTN system is very dependent on accurate data. In the past, GTN has been plagued with inaccurate or incomplete data. The purpose of this paper is to explore, through a variety of literature sources, possible causes for data inaccuracy in the GTN system. The Ishikawa fishbone diagram is the method used to propose possible cause-effect relationships among the important factors that affect data accuracy in the GTN system. Human factors, communication factors, and data standardization factors are identified as the main emphasis of this study.

This study suggests the following: first, human factors are the main cause for data inaccuracy in the GTN system; next, an adequate communication infrastructure is essential to maintaining accurate data; and finally, standardization is essential for all of the systems of GTN to operate accurately together.

The possible solutions proposed include making front-line data input easier, establishing data accountability and feedback, ensuring adequate training, developing an effective communications infrastructure, and standardizing the overall GTN system under a single manager.

DATA INACCURACY IN THE GLOBAL TRANSPORTATION NETWORK

I. Introduction

Background

The employment of military forces and combat power decides the outcome of campaigns and operations. The success of these forces often depends on sound, timely deployment and support. A well-defined, integrated transportation system is a critical part of this support. It provides time and place utility for units and sustainment. Inadequate control of logistic movement results in waste, reduced efficiency, and loss of potential combat power. (DoD, 1994: I-1)

As stated in the joint doctrine cited above, logistics support is a critical element of the successful application of combat power. Key to establishing a well-defined, integrated transportation system is the ability to maintain visibility of assets within that system. "In every major deployment during the 20th century, the Department of Defense (DoD) has been plagued by a lack of visibility over shipments and units entering a theater of operations" (DoD, 1995: iii). To the extent that this has occurred, our

nation's forces have lost some capacity to accomplish their mission efficiently and effectively. This point was highlighted vividly by our transportation efforts in Desert Shield and Desert Storm.

During Desert Shield/Storm, more than 20,000 containers of military materiel (out of 40,000) entering the theater had to be opened, inventoried, resealed, and then reinserted into the transportation system simply because military personnel in the theater did not know their contents. The movement of troops was also hampered by the lack of visibility over personnel moving into, within, and out of, the area of operations. In addition, 60 percent of evacuated patients ended up at the wrong destination. The DoD lacked timely movement status information needed to divert and reconstitute deploying unit and non-unit shipments. Fortunately, it had time to ensure that all deployed units received their necessary combat materiel before fighting began, a luxury that may not exist in future deployments. These shortcomings in logistics operations will continue to exist until the DoD implements a comprehensive in-transit visibility (ITV) capability. (DoD, 1995: iii)

Since the end of Desert Shield/Storm, ITV has received a great deal of attention. ITV is defined as "the ability to track the identity, status, and location of DoD unit and non-unit cargo and passengers, patients, and personal property from origin to consignee or destination during peace, contingencies, and war" (DoD, 1995:1-1). ITV is now

a high priority initiative of the DoD. Shortly after Desert Shield/Storm, the Assistant Secretary of Defense (Production and Logistics) developed a Total Asset Visibility Plan that provides for the phased implementation of key policies, procedures, systems, and related communications technologies required by operators and logisticians for essential visibility of DoD materiel assets (DoD, 1995:1-1).

Within the TAV plan there are three parts, of which ITV is one. The other two elements are in-process visibility (IPV) and in-storage visibility (ISV). Early on in the process to establish the TAV plan, the United States Transportation Command (USTRANSCOM) was given the task of developing the ITV component. The Army was given responsibility for the other two. The three components of TAV are defined below in terms of the assets they are designed to track:

In-transit Visibility-visibility all personnel and materiel that are being shipped from external procurement or repair sources, or moving within the DoD distribution system.

In-process Visibility-visibility of all assets that are either on order from DoD vendors but not yet shipped, or undergoing repair at depot-level organic or commercial maintenance facilities, or at intermediate maintenance facilities.

In-storage Visibility-visibility of all assets being stored at retail consumer sites (operating activity storerooms or warehouses); retail intermediate storage sites; contractor facilities (as government-furnished material); disposal activities; or wholesale depots. (DoD, 1995:2-11)

General Issue

The wheels are in motion for the Bosnia redeployment to begin in November of this year. To aid in the movement of assets out of the area of responsibility (AOR), USTRANSCOM is pressing forward with its plans to bring the latest version of the Global Transportation Network (GTN) on-line several months ahead of schedule. GTN is the tool USTRANSCOM has developed to meet its ITV responsibility.

The GTN system is a command and control system that provides the United States Transportation Command (USTRANSCOM) and its component commands with integrated, automated support to plan, provide, and control common user airlift, surface lift, and terminal services that deploy and sustain Department of Defense (DoD) forces on a global basis during both peacetime and war. The GTN system focuses on providing USTRANSCOM with the information necessary to carry out its mission of Global Transportation Management (GTM). (USTRANSCOM, 1995a: 1-1)

The GTN system performs this function by receiving data from existing Government and commercial transportation computer source systems and integrating this data into a

single database. This integrated data provides management information not previously available from the individual source systems (USTRANSCOM, 1995a: 1-1).

USTRANSCOM's goal is to be able to provide ITV of assets as they move from the AOR. The GTN system is the vehicle to accomplish this goal. Since Desert Shield/Storm, the early versions of GTN have been plagued with inaccurate data and have not been able to capture the information needed for ITV. Advances in technology make possible many new capabilities within the system but the question still remains as to whether data inaccuracy will be a major problem. The over-arching issue is whether all of the pieces of GTN will come together to make this goal of ITV a reality. Will the latest version of GTN be able to do the job?

Problem Statement

In June of 1996, I visited USTRANSCOM as part of the Advanced Study of Air Mobility (ASAM) program. In that visit, a demonstration of the GTN system was given. During that demonstration, attempts were made to find information on the movement of cargo from the United States to an

overseas destination. In every attempt that was made, the system was not successful in retrieving the requested information. Apparently, incomplete or inaccurate data had been fed into the system. However, the errant data could not be tracked to its source, so its origin could not be fully determined.

Since then I have concluded that accurate data input into the GTN system, as with any information system, is the critical link needed for success. According to the Defense In-transit Visibility Integration Plan, "Effective ITV is possible only if the Defense and commercial systems that feed GTN provide timely and complete data with a high degree of accuracy" (DoD, 1995:2-5). Past experience with the prototype of GTN identified data sources that were repeatedly unable to provide complete, accurate and timely data (DoD, 1995:2-5).

The purpose of this paper is to explore, through the literature, some of the possible reasons why inaccurate data is being stored in the GTN system. The goal is to reveal possible cause and effect relationships between the effect, inaccurate data, and the cause process which is comprised of

several elements. Once these relationships are established, possible solutions will be proposed. In so doing it is hoped that this research will eventually lead to greater accuracy of the GTN database.

Investigative Questions

This paper will attempt to answer the following questions.

1. What are the basic elements that input data into the GTN system?
2. What are some of the major causes for data inaccuracy in the GTN system?
3. What can be done to minimize data inaccuracy in the GTN system?

Methodology

The information presented in this paper will be taken from a combination of previous research, journal articles, government publications, interviews, and the Joint Universal Lessons Learned System (JULLS) database.

To help focus on a cause-effect relationship, the Ishikawa fishbone diagram from quality control principles

will be used. (Kaoru Ishikawa is one of the early pioneers of the quality movement.) Normally with the fishbone diagram (see Figure 1), the effect would be a desired goal but in this case the concept will be used to indicate an undesirable effect which we wish to eliminate.

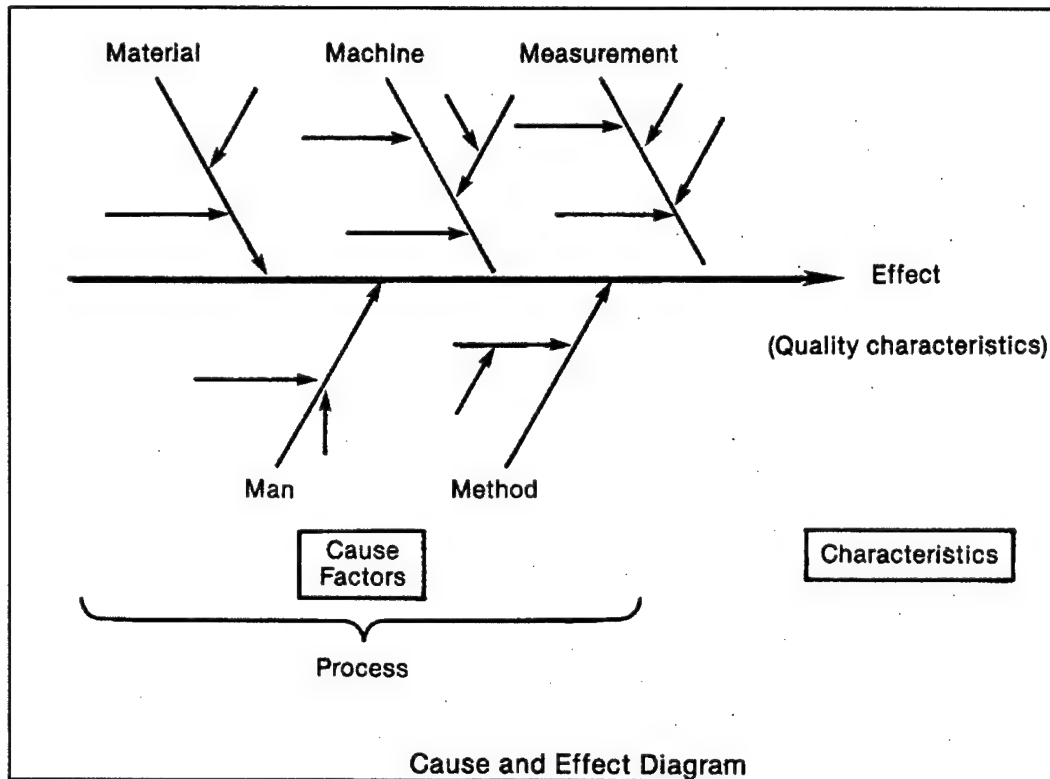


Figure 1: Cause and Effect Diagram (Ishikawa, 1985: 63).

This will be done in an effort to understand some of the causes that contribute to data inaccuracy in the GTN system. By understanding this inaccuracy, effort can be focused on those areas that seem to offer the greatest potential improvements. By maximizing data accuracy, GTN can provide

ITV for efficient and effective application of military power in the future.

Limitations

To explore all of the factors that contribute to data inaccuracy in the GTN system would be an impractical task. This research will attempt to focus on the most relevant factors. According to Ishikawa, "While there are many cause factors, the truly important ones, the cause factors which will sharply influence effects, are not many" (Ishikawa, 1985: 64).

II. The Components of GTN

Introduction

GTN is "the moonshot of logistics systems integration" (Saccomano, 1995: 44). Needless to say it is a very complex system of systems. GTN users include over 1,500 data customers, including the NCA (National Command Authority), Joint Commands, DoD agencies, military services, and USTRANSCOM and its component commands (DISA Vol. 1, 1995: 11). GTN provides USTRANSCOM and its three component commands with integrated automated information support to plan, provide, and control common user airlift, surface lift, and terminal services (DISA Vol. 1, 1995: 10).

The three component commands of USTRANSCOM are the Air Mobility Command (AMC), the Military Traffic Management Command (MTMC), and the Military Sealift Command (MSC). (For a description of the duties of USTRANSCOM's component commands see Appendix A).

GTN Components

When completed, the GTN database will be fed information from 19 different information systems (DoD, 1995:3-1). Currently there are eight components that supply data to GTN. GTN version 2.3 external components are as follows: 1) Consolidated Aerial Port Subsystem II (CAPS II), 2) Defense Automatic Addressing System (DAAS), 3) Worldwide Port System (WPS), 4) Global Decision Support System (GDSS), 5) Headquarters On-Line System for Transportation (HOST), 6) Mechanized Export Traffic System II (METS II), 7) Passenger Reservation and Manifesting System (PRAMS), and 8) Terminal Management System (TERMS) (DISA Vol. 1, 1995: 10). (See Figure 2). The systems above the top line are the systems that currently feed GTN data. The systems in the middle of the two dashed lines are future systems that will feed GTN. Below the second line are future systems that will receive data from GTN.

AMC owns and operates four of the eight components that currently feed GTN. They are as follows: CAPS II, GDSS, HOST, and PRAMS. MTMC, the Army component of USTRANSCOM, owns and operates three of the components.

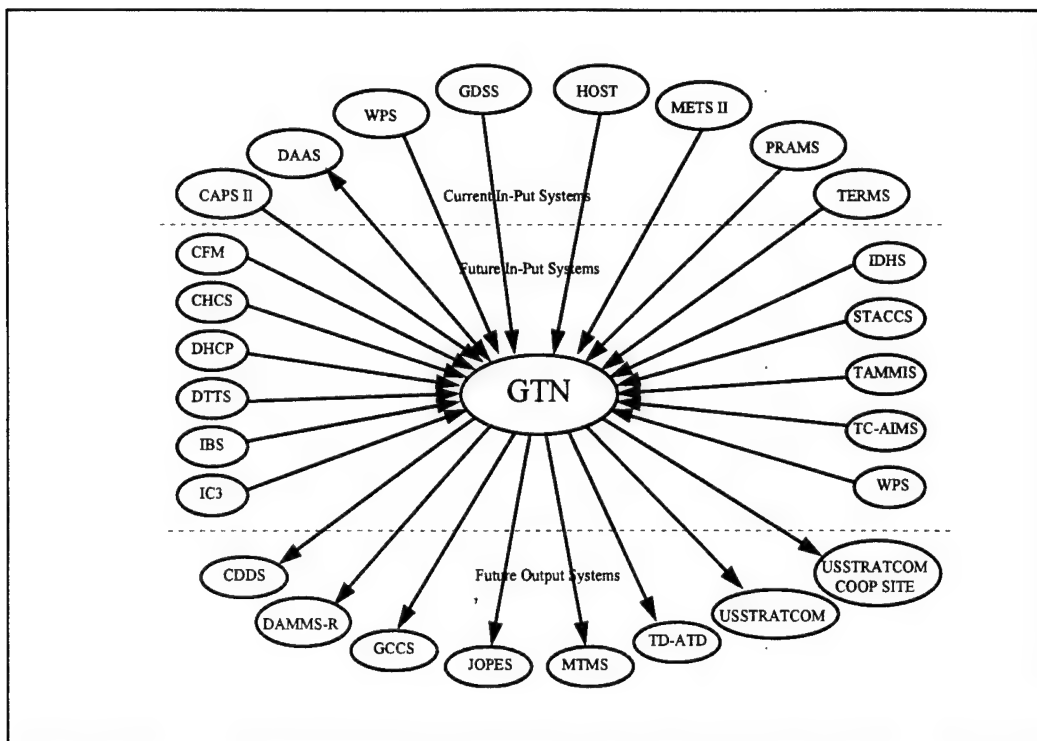


Figure 2: Component Systems of GTN (DISA Vol. 1, 1995: 21).

They are as follows: WPS, METS II, and TERMS. The last component, DAAS, is run by the Defense Logistics Agency (DLA) (Miller, 1996: 11).

Each of the components that currently feed GTN data are described below: (DoD, 1995: A3-A12)

CAPS II Consolidated Aerial Port System II (AMC)

A real-time, minicomputer-based system used at aerial ports to carry out local cargo, mail, and passenger processing functions. It operates through a dedicated circuit to Headquarters On-Line System for Transportation (HOST) computers. This system permits review and evaluation of cargo and passenger movements on a real time basis. It includes the Aerial Port Documentation and Management System (ADAM III) that supports cargo shipments and the Passenger Automated

Check-In System (PACS) that tracks passengers.

DAAS

Defense Automated Addressing System (DLA)

DAAS is an unclassified system for automatically routing Military Standard Requisition and Issue Procedures (MILSTRIP) transaction data among customers, suppliers, depots and shipping activities. DAAS is a both a source system and a customer system. GTN will receive movement status from initial shipment to final receipt by the consignee. It will provide shipment status information to Defense Transportation System (DTS) customers via DAAS.

WPS

Worldwide Port System (MTMC)

A new system being fielded that will function as the port operating system for military ocean terminals, Navy port activities, Army Transportation Terminal Units and Automated Cargo Documentation Detachments. It will replace TERMS and DASPS-E.

GDSS

Global Decision Support System (AMC)

GDSS is a system that provides unclassified and classified data concerning airlift mission schedules, actual departures and arrivals, aircraft status, advisory notices for exceptional events, and summary information on what an aircraft is carrying. GDSS is a source system. GTN will receive actual arrival and departure information, planned and actual itineraries, and summary allocations and manifests for all AMC carriers, tankers and aero-medical evacuation flights.

HOST Headquarters On-Line System for
Transportation (AMC)

HOST is an unclassified system that documents airlift cargo operations worldwide and provides detailed data concerning items of cargo arriving, departing, and on-hand at aerial ports. HOST is fed data from the 23 fixed ADAM-III sites and from the Remote Consolidated Air Ports System (RCAPS) which serves small/temporary aerial ports. HOST is a source system. GTN will receive information about manifested, airlifted cargo in-transit and cargo on-hand at AMC aerial ports.

METS II Mechanized Export Traffic System (MTMC)

METS II is an unclassified system for managing ocean cargo clearance authority functions for booking cargo on MCS or commercial ships. METS is a source system. GTN will receive specific information on cargo booked for ocean shipment (both containerized and break-bulk) and information on ship schedules moving military cargo.

PRAMS Passenger Reservation And Manifesting System (AMC)

PRAMS is an unclassified system that documents airlift passenger operations for DoD. It includes reservations and actual aircraft manifests on all AMC missions and commercial bookings. It is fed by the Passenger Automated Check-in System (PACS) and by all DoD passenger booking offices using PRAMS terminals. It can track individual as well as group (unit) moves. PRAMS is a source system. GTN will receive information on passenger manifests and itineraries.

TERMS Terminal Management System (MTMC)

Records cargo data for surface movements at MTMC area commands. It also facilitates cargo receipt, staging, and planning at ports and generates the ship manifest upon completion of loading. This system will be replaced by WPS.

GTN Concept of Operations

The GTN concept of operations depicts how GTN version 2.3 receives data from its component systems to populate the central database for the various users of the system (DISA Vol. 1, 1995: 14).

As represented in Figure 3, personnel and material from the shipper service enter the Defense Transportation System (DTS) at a convenient origin for shipment. In the movement process, several systems provide information to GTN to track lift requirements and status from the Port of Embarkation. PRAMS provides air passengers with reservation and manifesting information. CAPS II collects air cargo manifest and itinerary information. TERMS, METS II and WPS provide information to GTN on booking, manifesting, and transportation materiel being moved by ocean carriers (DISA Vol. 1, 1995: 15).

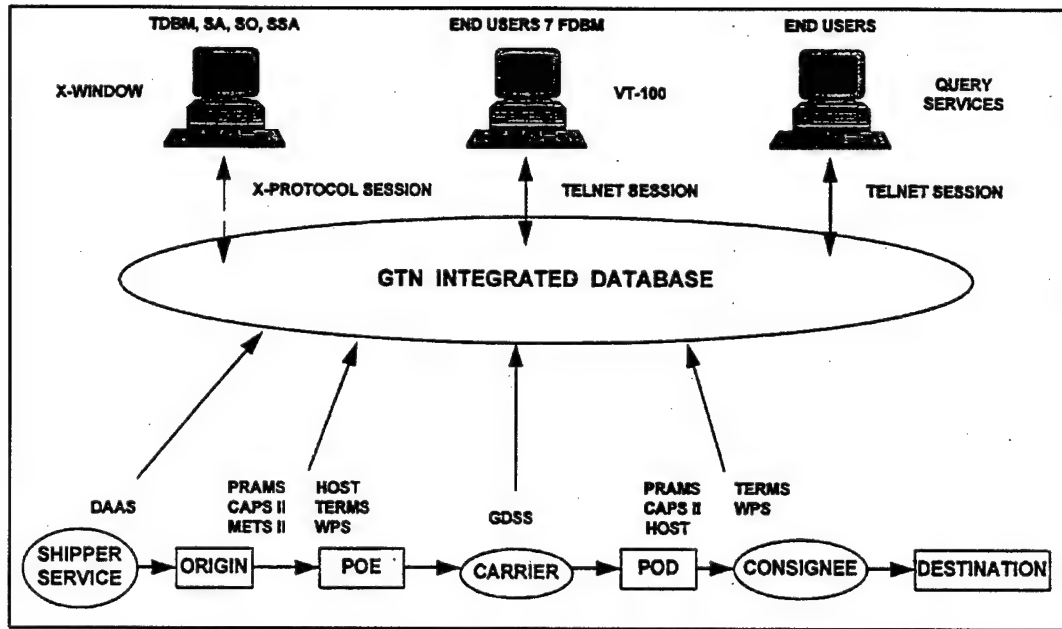


Figure 3: GTN Operating Concept (DISA Vol. 1, 1995: 14).

LEGEND	
CAPS II - Consolidated Aerial Port Subsystems	SO - System Operator
DAAS - Defense Automated Addressing System	SSA - System Security Administrator
FDBM - Functional Database Administrator	TDBM - Technical Database Manager
GDSS - Global Decision Support System	TELNET - Telecommunications Network Protocol
GTN - Global Transportation Network	TERMS - Terminal Management System
METS II - Mechanized Export Traffic System II	WPS - Worldwide Port System
POD - Port of Debarkation	VT-100 - Specific type of terminal emulator
POE - Port of Embarkation	X-Protocol - "X" version of a communications protocol, such as X.25 or X.400
PRAMS - Passenger Reservation and Manifesting System	X-Window - A type of graphical user interface
SA - System Administrator	

When an air carrier arrives at an Aerial Port of Debarkation (APOD), PRAMS and CAPS II supply GTN with data on the receipt of passengers and cargo respectively. PRAMS and WPS provide similar information to GTN on ocean going assets (DISA Vol. 1, 1995: 15).

This chapter was written to answer the first investigative question and to give a basic overview of how the components of GTN interact. Currently, there are nine source components that feed the GTN database. Over the next 10 years, GTN's source components will increase to 19.

The overall concept is that GTN, through the integration of these components, will give the warfighters transportation command and control capability and access to transportation deployment information (USTRANSCOM, 1995b: 2). To do this, the data entered into each one of these specialized systems must be accurate. This is particularly true as the GTN system grows in size and complexity.

With a basic overview of the components that feed GTN and a brief description of how they interact, a foundation is set to explore some of the cause factors for GTN data inaccuracy. Although the data input into each of the GTN components is mission-specific, it is hoped that possible underlying causes can be identified that affect the entire system.

III. Cause Factors

Introduction

"Data quality is the essential foundation for successful ITV" (Wolfe, 1994: 20). A major fault of the GTN system in the past has been inaccurate data. Today data accuracy is still a top concern. If the components of GTN are fed inaccurate data, the system will not be able to provide ITV. The goal of this chapter is to identify possible underlying causes that contribute to data inaccuracy in the GTN system. This effort will be focused in three areas: human error, communication error, and data standardization error.

Human Errors

Currently, millions of dollars are being spent to establish GTN and its infrastructure. Loral Defense Systems East Corporation is in the process of installing a complex hardware and software package that will be the backbone of GTN (Bonney, 1995: 84). Some believe that the new technology being put in place by Loral will solve

USTRANSCOM's problems with ITV. However, no matter how sophisticated the hardware or software, initial data entry into the system will be done by human beings. This initial data entry by humans is a major potential source for data inaccuracy. For example, before an item can be bar coded, the computer that produces the code must be fed the right information by human hands. If it is not done correctly from the start, inaccurate data will be input into whatever system reads the bar code from then on. Therefore, it is essential that we examine some of the reasons or ways that humans introduce data errors into information systems. In so doing, an overall concept will be developed which could be used to evaluate the data entry procedure for each component system of GTN.

Data errors can be introduced by humans either intentionally or unintentionally. In some cases, it is a combination of both. It is important to look at the basic reasons behind intentional and unintentional data entry errors to understand what can be done to improve the GTN database.

In two studies of military maintenance information systems, the causes for intentional and unintentional data errors were examined. The studies were done on information systems that are similar to the GTN system; therefore, the principles behind the errors should be applicable. Both of these studies used a survey of those that used the respective system to identify some of the causes for human data input errors.

The first thesis was written by Captain Thomas L. Folmar in 1986. The Folmar study concentrated on intentional errors input into the Maintenance Data Collection System (MDC). The second study was a follow-on study by Captain Jon R. Determan. The Determan thesis, written in 1991, uses the Folmar study to address the causes of data inaccuracy in the follow-on information system to MDC, CAMS (Core Automated Maintenance System). In the Determan study, both intentional and unintentional data input errors were addressed. These studies will be used along with current GTN issues to suggest human factor causes for data inaccuracy.

Intentional Human Errors. According to Determan, an intentional error is one in which the person inputting errant data knows that it is incorrect at the time of entry (Determan, 1991: 3). The question is, why would anyone intentionally load errant information into a military database? *Lack of integrity* and/or *discipline* may obviously be reasons. But the purpose of this study is to identify additional, systemic factors which might otherwise be overlooked.

In the Folmar study, the MDC system was the primary means of obtaining base-level maintenance data. Use of the MDC system was widespread throughout the Air Force and the need for accurate data was essential to a decision maker's assessment of overall force readiness. Folmar's focus was to determine how widespread intentional errors were and the primary causes for these errors (Folmar, 1986: 1).

From a 1983 GAO report evaluating the accuracy of the data in the MDC system, Folmar reported that "there is little, if any, incentive for personnel to accurately report maintenance data" (Folmar, 1986: 15). This lack of incentive was due to the fact that those who input the data

had no use for it on the job and were unaware of its usefulness to the Air Force. *Lack of feedback* was cited as the main reason not to care about data accuracy.

In the Folmar study, base-level managers were not motivated to press for accurate data because the data was difficult to obtain and access (Folmar, 1986: 15-16). In the Determan study, similar to the Folmar study, motivation was an important issue. "Indeed, motivating people to do what they should do has always been a dilemma to managers" (Determan, 1991: 14). In his discussion about motivation, Determan described the pressures that exist in the maintenance field and the demands that are put on those within it. According to Determan, these pressures "have direct bearing on the data entry environment" (Determan, 1991: 14). In both studies, it appears that low *motivation/morale* of those inputting the initial data into the MDC and CAMS databases were cause factors for data inaccuracy.

Along with the factors of *integrity/discipline*, *lack of feedback*, and *motivation/morale*, the results of Folmar and Determan's surveys suggest additional causes for intentional

data errors. *Lack of time* for data entry and *input difficulty* were high on the list in both studies. In addition *lack of adequate training* also appeared in both surveys to be a major cause (Folmar, 1986: 52 & Determan, 1991: 62-63). Each of these cause factors should be considered when examining the components of GTN.

The cause factors discussed above should apply well to the components of GTN. The GTN system is very complex but so were the systems studied by Folmar and Determan. In addition, the front-line data entry environments of the GTN components are similar to that of the MDC and CAMS systems. The question is what motivates personnel to pay attention to detailed data entry in an environment that is demanding, such as an aerial port, seaport, or maintenance line. In this type of environment, data entry may be perceived as more a nuisance than a necessity.

Along with the Folmar and Determan studies, a current GTN issue will also be examined for possible cause factors. When it comes to the movement of military assets, there are many different customers that USTRANSCOM must serve. Day-to-day movement of assets usually runs fairly smoothly but

when it comes to a conflict or contingency, things change. The supported Commander-in-Chief (CINC) of a conflict receives resources across command and service lines. All of the units supplying these resources are competing for transportation of their assets. Everyone wants their equipment to arrive first so that they can accomplish their mission. Rivalry between different units and political forces cause those inputting data, to take the easiest and quickest route to get their assets moved. This pressure may even contribute to falsification of data just to get the job done. In this sense *job and political pressures* could be a possible cause for data inaccuracy.

The subject of contingency movement was address during an interview with Colonel R. Stephen Bunn of AMC/DOU. Colonel Bunn is in charge of ITV requirements issues at AMC. The following is an exert from his interview.

The problem that we have is in deployments. In deployments, everybody is in a hurry to move-- they just throw it on the airplane. Now, when I was in Somalia, they tried to enforce the ULN (Unit Line Number) for units coming over. We had remote CAPS (Consolidated Aerial Port Subsystems) at March AFB for the capture of all the ULN information but what happened was that the people being moved did not know what a ULN was. The JOPES (Joint Operation Planning and Execution System) planners knew but the units did not. In

order to capture the information during a deployment you have to have the discipline to say, "you're not getting on that airplane without proper documentation." Then you must check to see if it is right. In this situation, someone at March found a ULN that would work so everybody going to Somalia used the same ULN. When they went back and looked at JOPES, they had one ULN that move a huge number of times what it was really supposed to and the other ULNs had not moved at all. (Bunn, 1996: Interview)

With pressure to get the job done and finding a way to do it, inaccurate data was intentionally input into the system. Although again, integrity could be cited as the cause, it appears that *inadequate training, job/political pressure,*

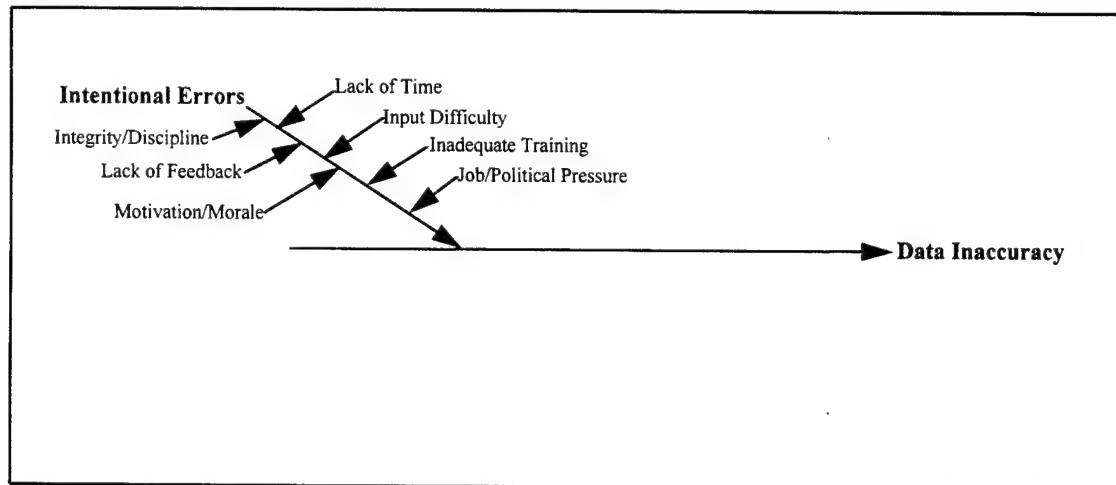


Figure 4: First Partial Fishbone.

and possibly *lack of time* for data input contributed to the data inaccuracy in this situation.

Although not all-inclusive, the above fishbone diagram illustrates the main causes for the intentional data errors that were discussed.

Unintentional Human Errors. Unintentional errors are probably more common than intentional errors. Usually, many factors can combine to cause a degradation of data accuracy that is hard to pinpoint. The environment in which data is collected and input has a lot to do with unintentional errors. Unintentional human errors are those errors introduced into the database without the knowledge of those who input them.

In the Determan study, causes for unintentional or accidental errors were addressed. In his literature review, Determan explored some of the *ergonomic factors* that contribute to unintentional data error. The question was whether the design of processing techniques contributed to data inaccuracy. In his research, Determan did identify the design process as a contributing factor, but it was also stated that the impact of process-related errors were difficult to assess (Determan, 1991: 12).

Turning to Determan's survey results, a majority of the maintenance personnel identified the three most likely causes of accidental errors. From their perspective, they were due to keystroke errors, inadequate training, and difficulty in finding the correct codes to enter information into CAMS (Determan, 1991: 63). These three cause factors are accounted for in this study with two fishbones, *inadequate training* and *lack of experience*. Training, job experience, and finding the right information to enter into the system are interrelated factors and thus can be accounted for by two fishbones.

A complicating factor in the military system equation is that personnel come and go frequently. Frequently, those who fill a position do not have much practical experience in the job they are filling. An example of this was found in a Joint Universal Lessons Learned System (JULLS) report from Operation Restore Hope.

In haste to establish an ITV cell at AMC, personnel selected to work in the cell were from various locations on a TDY basis and did not have the opportunity to be completely trained nor did they have the necessary equipment available.
(Miller, 1992: JULLS 22451-98027)

Due to the lack of training of the personnel in this situation, mistakes were made in reporting that caused a loss of ITV. Frequent movements, PCS or TDY, create the need for more training and contribute to an overall *lack of experience*.

In a contingency environment, the impact of *inadequate training and lack of experience* are magnified and can definitely lead to data input errors. Too often, due to this changing military environment, action is taken at the last minute where satisficing is the norm because of time constraints. One of the potential causes for inaccuracy in the GTN database is the tendency to accept partial or incomplete data due to this *changing environment*.

During a contingency, *inadequate training and lack of experience* can combine with other elements to create a concept known as the "fog of war." This concept is like an extra layer of confusion at all levels. Loss of data is very likely under these circumstances. If, due to the "fog of war," data is lost or not entered properly into the GTN system, ITV is quickly lost. The "fog of war" concept and *changing environment* factors were evident at Dover AFB

during the sustainment phase of Joint Endeavor. In mid-November of 1995, Dover experienced a large backlog of cargo. The following is an exert provided by one of the historians at USTRANSCOM.

USTRANSCOM first became aware of an airlift sustainment cargo backlog during Operation Joint Endeavor when the Army in mid-November 1995 reported a loss of visibility of over 50 tons of winter clothing bound for U.S. forces via the channel airlift from Dover Air Force Base, Delaware, to Ramstein Air Base, Germany. Researching the problem, USTRANSCOM determined that half of the shipment had arrived at Ramstein and the rest was being shipped out of Dover as quickly as possible. Several factors contributed to backlogs at Dover and the loss of in-transit visibility (ITV) over sustainment cargo during Operation Joint Endeavor.

One of the main factors was that cargo arrived at Dover with incomplete or no documentation. According to USTRANSCOM, there were several reasons the Army was losing ITV of cargo. On 4 December 1995, a fact-finding team--consisting of representatives from the Army Staff (Logistics) and Logistics Support Agency (LOGSA)--visited Dover and found that loss of cargo visibility was due, in part, to poor documentation, such as completing the wrong blocks on manifest forms and shipments from vendors that did not have ITV capability. Advance Transportation Control Movement Documents (ATCMDs), in many cases, did not reach Dover before the cargo did, delaying shipment of the cargo while aerial port workers verified the cargo's clearances through the Air Clearance Authorities. In addition, lack of documentation meant the shipment was processed outside the system and, consequently, manifest information was never entered into the Army's Logistics

Intelligence File (LIF). In some instances Army cargo arrived in Europe before it showed up in the LIF. (Nigra, 1996:1)

Across service lines it is particularly difficult to determine the exact cause for poor documentation and data input quality. Clearly, confusion or the "*fog of war*" was a major factor in this situation. Part of the confusion that took place was due to the fact that some vendors did not have ITV capability. Without vendor or source ITV input capability, the source data had to be input at some place down the transportation chain. This is a typical example of the *changing environment* in the military.

The bottom line is that data, if it is to be accurate, must be input into the system at the source of generation and it must be input correctly the first time. Attention to detail is a requirement at the start. If it is not, a ripple effect takes place down the line that negatively impacts the mission. This point was illustrated in a message sent from EUCOM (European Command) during the deployment of Operation Joint Endeavor. The message dated 27 December 1995 was titled, "Proper Documentation and Marking of Cargo."

Cargo continues to arrive with incorrect documentation and pallet markings (no unit Ids or TCNs), negatively impacting tracking, locating users, visibility and interface with USAF automated cargo tracking systems. This has resulted in constrained cargo throughput and is tying up limited ramp/storage space while cargo is sorted out.

Request your assistance in ensuring that all cargo moved forward is properly documented and marked per existing regulations. This problem can only be rectified by following established procedures and following through with the attention to detail necessary to ensure delivery to the proper location and, most importantly, the end-user of the cargo. (EUCOM message 526, 1995)

Lack of attention to detail was a possible cause factor in this situation.

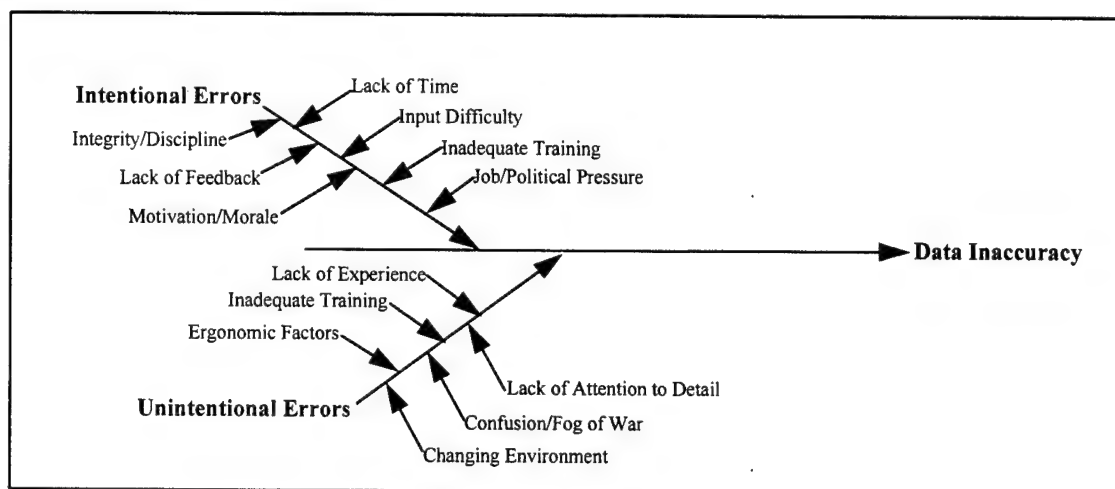


Figure 5: Second Partial Fishbone.

The additional sources of inaccuracy discussed in this section have been added to the diagram in Figure 5.

Communication Errors

Adequate communications are vital to obtaining accurate data in the GTN system. The two areas of concern in this section are communications between the components of GTN and the lack of an adequate communications infrastructure.

The components of GTN must be able to communicate with each other. If they cannot communicate, disconnects occur that lead to input and tracking errors. Disconnects can be either vertical or horizontal. A vertical disconnect is between command components and execution components while a horizontal disconnect is between execution components.

Along with disconnects, data accuracy depends upon an adequate communications infrastructure. The volume of communications traffic, transmission time requirements and systems security are all factors that define what type of infrastructure is adequate.

System Disconnects. The Secretary of Defense chartered USTRANSCOM on 14 February 1992 with the mission to provide global air, land, and sea transportation to meet national security objectives in times of war and peace (USTRANSCOM, 1995b: 4). Prior to that time, most of the systems that

provided command and control (C²), communications, and visibility of assets were specialized to their respective modes of transportation. These systems were also, in general, specialized along service component lines. The systems and services performing a certain task were what is referred to in the military as "stove-piped." From planning to execution, each system operated autonomously. The overall process functioned well vertically but, horizontally, gaps existed. These systems rarely, if ever, had cause to communicate with each other. Since the formation of USTRANSCOM, one of the many challenges has been to integrate each of these vertical or "stove-piped" systems into an ITV capability for the entire Department of Defense.

Vertical disconnects occur between the joint planning system that is used to plan the required movement of assets and the Defense Transportation System (DTS), which is responsible for the actual assets movement. Generally, planning is done at a Joint/Specified Command or Service Component level. Actual movements, on the other hand, are made at the unit level. The DTS receives the actual movement requirement and then makes the move happen. The

planning system and DTS both provide related capabilities to a similar group of customers without exchanging data. This is where the vertical disconnects occur. Difficulty in establishing adequate communications channels between these two systems has resulted in confusion and data inaccuracy.

The difference between planned and actual movement requirements and the need for current movement status during a crisis define the need for viable communications between the two systems.
(USTRANSCOM, 1995b: 6)

Horizontal disconnects occur because of the difficulty associated with trying to get all of the specialized systems of the DTS to communicate with each other. It is very difficult to establish horizontal communication across systems that have functioned well in a stove-piped environment.

Horizontal disconnects exist between the individual systems that are responsible for DoD transportation. The Military Standard Transportation and Movement Procedures (MILSTAMP) provide the policies, procedures, and data standards for DTS but do not coordinate or integrate the air and surface systems that make up the DTS. These disconnects become apparent during planning and execution. C² of the transportation process requires the ability to "see" variations in actual and planned movement requirements and movements to control the use of transportation assets. (USTRANSCOM, 1995b: 6)

Just as with *vertical disconnects*, *horizontal disconnects* between these systems cause data inaccuracy and duplication. Problems with the system occur when these originally stove-piped systems are not fully integrated into the overall structure of GTN. Communications are the critical element that allows system interfaces to be established and to be effective. GTN is supposed to bridge the gap between systems with a set of system interfaces. (See Appendix B for a list of present and future interfaces of GTN and the systems that they are to integrate.) Until these communications gaps are bridged, data inaccuracy may be expected.

Communications Infrastructure. Without adequate communication between the systems that make up GTN, data even if it is accurate, can not get into the system. Like front line data entry, communications are vital to obtaining the goal of ITV. The following is a portion of a JULLS report from Somalia in October of 1993.

Discussion: Without reliable communications, data relating to cargo and passengers to/from deployed sites cannot be prepositioned or reported. If the data cannot get into GTN, then USTRANSCOM and a myriad of other GTN users have no visibility of cargo/pax on-hand, arriving or departing the deployed location. This negatively

impacts ability to make effective management decisions regarding sustainment, distribution of assets, and required logistical support for redeployment to CONUS. (Schweickart, 1993: JULLS 13148-33201)

GTN is a very complex system that is dependent on a solid communications infrastructure. The concept of data flow is represented in Figure 6 below. Within the United

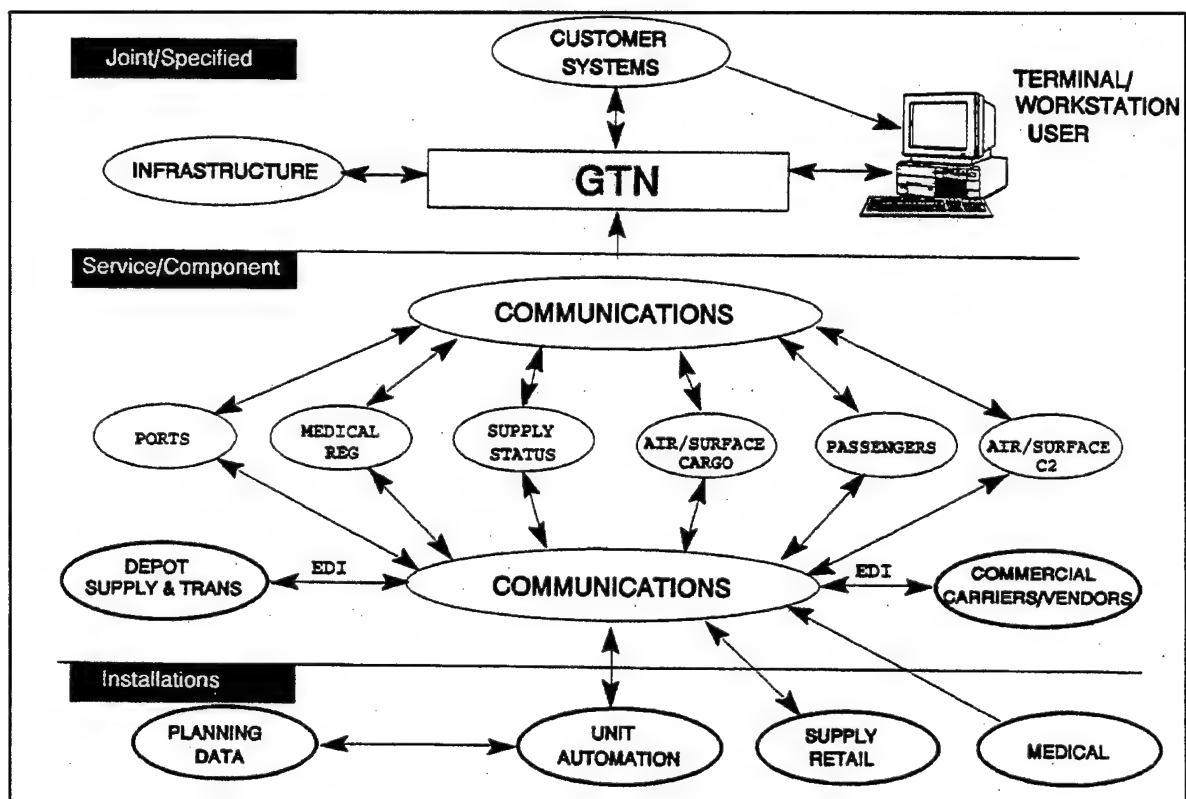


Figure 6: GTN Data Flow (USTRANSCOM, 1995b: 3).

States, the communications infrastructure is widespread and robust. Outside the Continental United States (CONUS) it is another story. In the worldwide picture, communications are

a major constraint when looking at getting the right data into the GTN database.

In a briefing given for the DIRMOBFOR (Director of Mobility Forces) course at the Air Mobility Warfare Center, Colonel R. Stephen Bunn, (cited earlier), stated:

The Air Force has not put enough money into communications. All those lines of data transfer (referring to GTN) depend on communications. We have put a lot of money into "boxes" (referring to computer systems) but we have not put enough money into deployable communications. Without an infrastructure none of this stuff works. When you see video and graphics that requires big pipes (referring to data transfer capacity or transmission rate). We do not have big pipes yet. We have little pipes. At Vincenza for the deployment we had a 9.6 line (referring to a 9.6 baud rate modem line with a data transfer rate of 9.6 Kilobits of data per second). It was the best we could do to get all the information in and out. So we had problems, things did not happen quickly. With airlift as fast as it is, for ITV to work, you have to pass things fast back and forth. You have to have adequate communications to do that. There are ways of solving these things but we have to spend the money on the infrastructure or it will not work. (Bunn, 1996: Lecture)
(Clarification added)

In conjunction with the above discussion, system security requires even greater transmission capability and capacity. Again from JULLS, this point is demonstrated in a

report titled, "Inadequate Secure Communications for ITV Data."

Discussion: WPS requires high performance communications for transmission of manifests and GTN updates. In the event that required communications facilities are not available, WPS can make use of INMARSAT (International Maritime Satellite). This would normally not be encrypted since the data being sent is unclassified and could be sent at the full WPS modem speed of 19,200bps. If encryption is required, INMARSAT and a STU III (Secure Telephone Unit III) modem would be too slow and error prone.
(Norconk, 1995: JULLS 03135-36529)

Although WPS data could be sent without encryption, normally in a contingency, higher security would dictate the need to operate under this requirement. The need for security not only requires greater capability but can also be a source of data inaccuracy in the system. When the STU III modem was used in this situation, the data was more prone to errors. The capability to transmit secure data is vital to the success of the GTN system.

Encryption of data transfer is not the only security issue. Although WPS is unclassified, some of the GTN systems are classified.

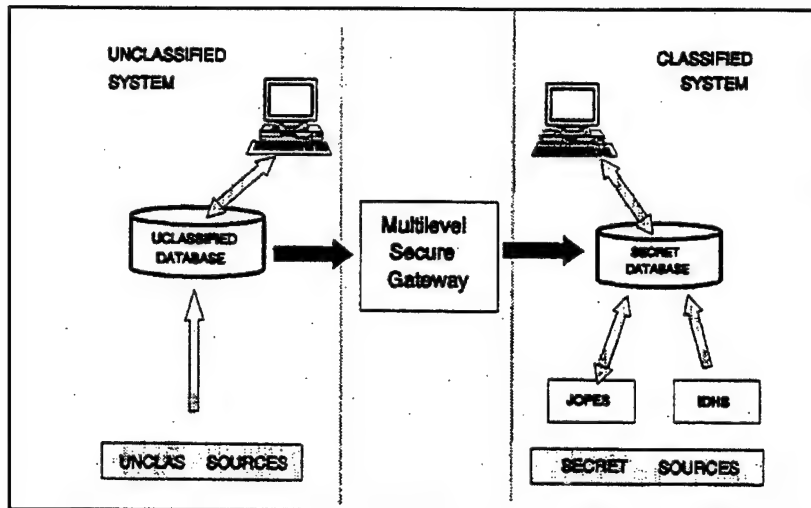


Figure 7: Security Architecture (USTRANSCOM, 1995b: 33).

To support the requirements of other unified commanders, GTN must maintain a SECRET database that allows combatant commanders to view their logistics situation, express concerns, and manage force movement plans in a protected environment. GTN data classification must be compatible with the Global Command and Control System (GCCS) to support CINCs Services, and other DoD customers. (USTRANSCOM, 1995b: 34)

To accommodate classified data the communication infrastructure within GTN must be able to support an internal security architecture (see Figure 7). This architecture puts more demands on the communications links between systems and the overall infrastructure.

A main cause for data inaccuracy in the GTN system is the *lack of an adequate communications infrastructure*. In addition, there is a shortage of adequate deployable

communications systems. Without investment in communications, GTN will not function as designed.

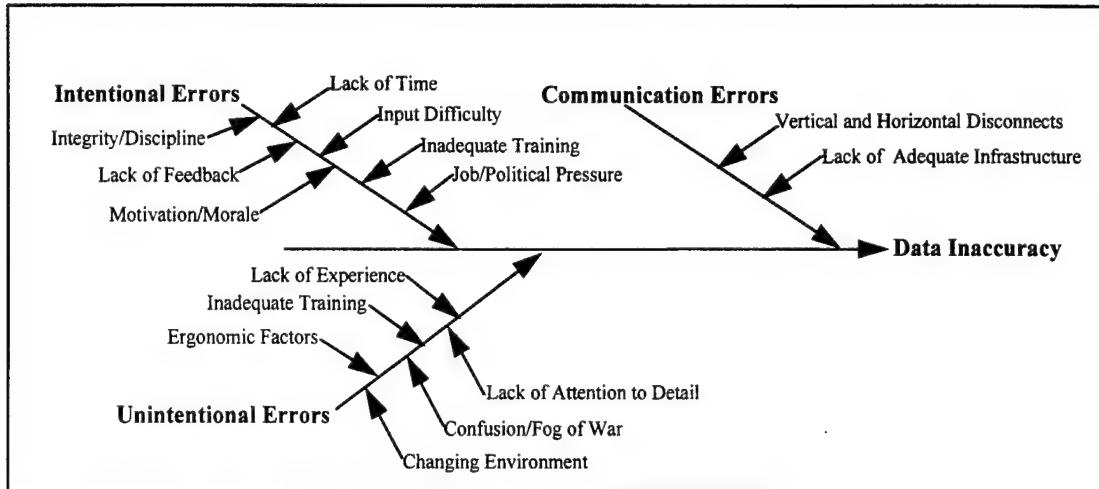


Figure 8: Third Partial Fishbone.

Data Standardization Errors

Along with human and communications factors, standards are essential to data accuracy in a system as complex as GTN. The current system has over 8,000 different users and when complete will accommodate 45 customer interface accounts (USTRANSCOM, 1995b: A-11,12). Standards are needed across service lines that control operating policies, training, data protocol, and electronic transmission for the GTN system to meet the DoD's goal of ITV.

Operating Policies. An operating policy is a set of procedures, regulations or instructions that outlines how a

system should be operated. Currently, there are several different operating policies that attempt to control the various components of the ITV process. These operating policies are confusing and are a source of data inaccuracy.

DoD currently maintains separate transportation regulations and procedures for various transportation applications. They include the Personal Property Traffic Management Regulation (PPTMR), Defense Traffic Management Regulation (DTMR), and MILSTAMP, to cite three. These and other documents are sometimes out of date or redundant; use antiquated standards and formats; and, in some cases, require the use of different codes for the same purpose. (DoD, 1995: 2-5)

Without a standard ITV operating policy, GTN can not establish training, data protocol, or electronic transmission standards that are needed to promote data accuracy. A standard operating policy is needed as a foundation. The current *lack of an overall operating policy* is a cause factor for GTN data inaccuracy.

Training. GTN data standards cannot be enforced if those inputting the data do not know what the standards are or they do not know how to apply them. As addressed earlier in the human factors section, lack of training contributes to data inaccuracy. Currently, the respective services are

responsible for the training that their personnel receive (Bunn, 1996: Interview). This training is not standardized. Many differences exist between the services and these differences are manifest in the training that is given. "The services have to train their people properly from the very beginning and make sure those processes are in place to ensure that the data is accurately captured" (Bunn, 1996: Interview). *Lack of Training Standardization* contributes to data inaccuracy.

Data Protocol. Some of the current systems that feed GTN allow the user to input data in different formats. These differences could produce data inaccuracy in the GTN system. Computers generally will only recognize an input if it is made according to the design protocol. For example, if the correct designation in GTN for a C-5 aircraft is "00C5" and GTN will not recognize anything else, a problem arises when a feeder system accepts "C5" or "c-5". AMC has that exact problem between C2IPS and the system it feeds, GDSS. GDSS will only accept data in a specific format while C2IPS will accept just about any format (Bunn, 1996: Interview). In turn, GDSS is a feeder system to GTN and

thus C2IPS protocol could be a source of data inaccuracy to the entire system.

Electronic Transmission Standards. Since the Gulf War, the number of commercial suppliers to the DoD logistics system has steadily increased. "During Desert Shield/Storm, 36 percent of all resupply shipments came directly from commercial vendors" (DoD, 1995: 3-14). The main method that the commercial industry uses to pass data is through its own electronic transmission standards.

A major reason for the poor quality of DoD transportation and supply data is the lack of electronic transmission standards. DoD needs to increase the use of Electronic Data Interchange (EDI) to fill this void. Commercial industry has learned that the development and use of Accredited Standards Committee (ASC) X12 implementation guidelines reduces data compliance errors. Although DoD has begun to implement large EDI programs, it needs to expand the use of EDI. (DoD, 1995: 2-5)

Without electronic transmission standards, GTN can not capture the complete ITV picture, particularly that of the commercial data.

Summary

From the factors listed on the fishbone diagram (see Figure 9) developed in this study, an overall cause-and-

effect relationship has been postulated. The next chapter suggests some possible solutions or areas of investigation that may contribute to greater data accuracy in the GTN system to facilitate ITV.

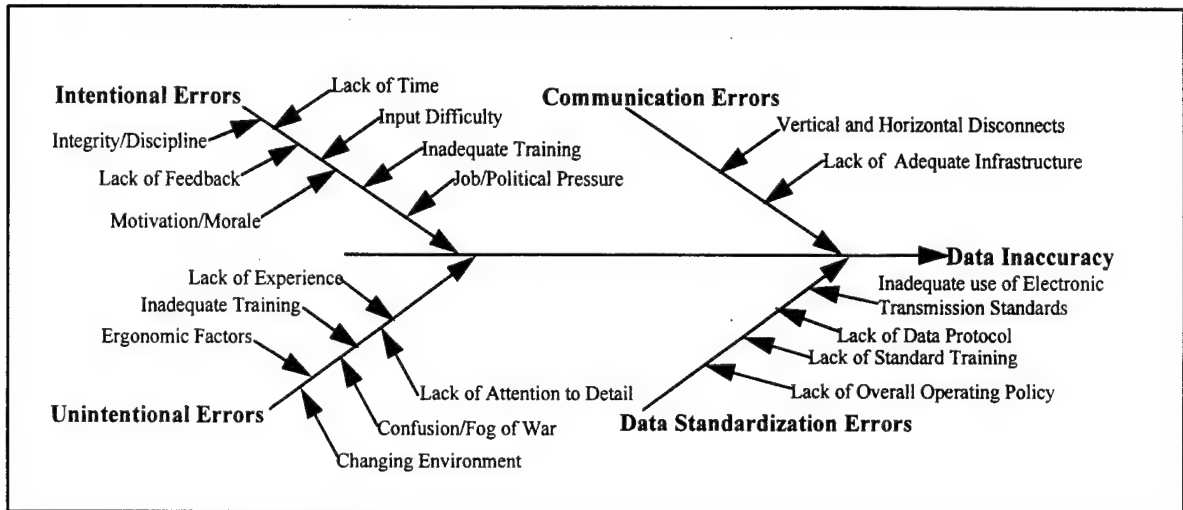


Figure 9: Final Fishbone.

IV. Proposed Solutions

Introduction

As illustrated by the final fishbone diagram in Figure 9, there are several factors that can cause data inaccuracy in the GTN system. The factors identified in this study are not by any means all-inclusive. However they provide a good initial basis for identifying possible solutions or areas of investigation for the truly important issues that may affect GTN data accuracy. The main factors identified in this study were human (intentional and unintentional data errors), communication, and data standardization factors. The possible solutions that will be addressed are: making data input easier, establishing data accountability and feedback, adequate training, adequate communications infrastructure, and system standardization.

Human Factors

One of the principles of data quality is that it is essential to properly capture a data element at its source. Attempts to fill data elements downstream require ancillary

data that are not always available in a timely fashion and may have data quality problems of their own (Galway, 1996: 38). This concept was illustrated in the Dover cargo example cited in Chapter 3. The constraint of human factors data entry is that the initial input is made by human hands. If the initial data can be entered correctly into GTN from the start, a majority of the problems with data inaccuracy will be solved.

Easier Data Input. Under intentional errors, *lack of time* to input correct data and *input difficulty* were cited as cause factors. To overcome these factors it is essential that data capture be made as easy as possible for the front-line worker. If capturing the data is done in a manner that requires less effort to complete and fits in with the normal sequence of a task, a worker should be more likely to do it and do it properly. If *ergonomic factors* are considered in the design process of easier input, this factor can also be accounted for.

The key is to allow the worker to input data more accurately in less time by making the task easier to accomplish. If data input can be made easier, it will in-

turn reduce the effect of *job and political pressure* felt by the worker and it can also aid in improving *motivation and morale* on the front-line.

In conjunction with making data input easier it is essential to reduce manual input. The more humans interact manually with data input, the higher the potential is for input errors. For example, the potential for a keyboard error goes up as the amount of data input manually from the keyboard increases. As much as possible, the data input process should be automated. One of the tools that promises to be a very useful in minimizing manual input errors is Automatic Identification Technology (AIT).

AIT is any technology that automates the collection of data and transfer of that data to a database. AIT gains are greater speed (productivity), accuracy, system integrity, reduced paperwork, and greater information. Examples of AIT include bar-coding, magnetic strip cards, computer-chip memory buttons, radio networks, and portable computers for immediate on-site data input. (AFCESA, 1994: 1)

Currently, USTRANSCOM is evaluating AIT to determine how it might best be applied to the GTN system. Two application technologies within AIT are the front runners

for use in capturing ITV data. These technologies are bar coding and radio frequency identification (RFID) tagging.

Bar Codes: Bar coding technology has been around for quite a while. It is used commercially in stores to speed merchandise check-out and in the warehouse to track inventory.

A bar code is an array of parallel narrow rectangular bars and spaces that represent a single character in a particular symbology. These bars and spaces are arranged in a particular order defined in the symbology. Bar codes are printed, scanned, decoded and then transferred to a host computer. This technology relieves the user of the tedious and error-prone task of having to read an alphanumeric label on an object and then transcribing the label contents onto a paper form or key-entering database. With bar code technology, the time required to identify objects and enter the identity code into a database has been significantly reduced for many logistics-related operations at warehouses, retail stores, battlefields, hospitals, etc. (AFMC, 1995: 2)

GTN front-line data input would be much easier if the assets being shipped by the DTS were all bar coded.

Technology can and will help. The easier it is for deploying units and shippers to prepare their documentation before movement in standard bar code-readable and electronic-readable format, the easier it will be to track information from points of origin via rail, road, water, and air modes and the interfaces between these modes. (Woodworth, 1993: 20)

All that would be required by a pallet builder would be to scan a bar code as a pallet was built. This is very similar to what is done at Fed-X, UPS and Emery Air Freight to provide visibility of the packages that they ship.

In the past, the amount of information that was capable of being passed in a bar code was rather limited. Currently, two dimensional bar coding promises to provide the capability to record enough information for the GTN system to not only track a pallet but to track its contents also.

Two dimensional bar codes is a generic term usually used to refer to larger capacity bar codes. While linear bar code can encode up to 17 characters, a two dimensional bar can store 2,000 characters in a relatively small space (6 square inches). Two dimensional bar codes are also able to sustain considerable damage and still maintain readability. (AFMC, 1995: 2)

By supplying the front-line worker with the capability to use bar coding technology, data input can made more easily and accurately.

RFID Tagging: RFID tagging is a relatively new technology, compared to bar coding. The system is comprised of a radio frequency identification tag or transponder and a

controller unit referred to as a reader or an interrogator (AFMC, 1995: 17).

RFID interrogators communicate with tags through the use of radio frequency (RF) energy. The interrogator sends out an RF signal which "wakes up" the tag, and the tag transmits information back to the interrogator via RF. In addition to reading the tag, the interrogator uses RF energy to write new information to the tag. This enables the user to alter the information stored in the tag from a distance. Interrogators can be networked together so as to provide nearly unlimited coverage of a system. (AFMC, 1995: 17)

The Army currently favors and is using RFID tagging to store and transmit asset movement data. RFID tagging also has great potential to ease the input of data for the front-line worker.

U.S. Transportation Department cargo tracking specialists are helping the U.S. Army create a system for tagging nearly all military cargo headed for Bosnia so it can be tracked electronically and monitored via satellite.

Commercial electronic tags will be put on nearly all containers headed into Bosnia. The tags, which will include cargo data, have small radio transmitters with a limited range that can communicate with interrogation units. (Hughes, 1996: 67)

The RFID tagging system is more useful when tracking larger scale containers or vehicles carrying cargo. When used together with bar coding, RFID tagging has great

potential to speed up data input while at the same time increasing data accuracy.

Establishing Data Accountability and Feedback.

Essential to the success of the GTN system is establishing accountability for those individuals and organizations that input front-line data into the system. In addition to accountability, data quality feedback must be given so that those responsible for the data will have the information that they need to improve their input process. Establishing data accountability and feedback is the mechanism needed to control the cause factors of *integrity/discipline* (intentional errors) and *lack of attention to detail* (unintentional errors).

Key to establishing accountability and feedback is the necessity that a single organization control the process. That is the concept behind USTRANSCOM becoming the focal point for ITV. The challenge is to overcome the barriers that currently exist between services and organizations.

Retired U.S. Army general and president of the Logistics Management Institute (LMI) William G. T. Tuttle

Jr. suggests in an article entitled, "Control and Accountability--Key to In-Transit Asset Visibility," that the fundamental problem with the DoD transportation system is control. He feels that the DoD can learn a great deal from the commercial industry in this area (Tuttle, 1993: 14).

To contrast control in DoD and commercial systems, look at Federal Express. The Federal Express driver on a route--the one that comes to LMI for example--comes in with a little hand-held computer with a transceiver built into it, picks up or delivers a package, and enters the package number onto the key pad. That computer transmits it to the truck and into the Federal Express network. The interesting thing about the transceiving activity is that embedded in that computer is an employee identification number. After visiting Memphis and looking at the system in the Operations Center at Federal Express in some detail, it appears to me that Federal express knows who is responsible for a particular package at any given time. There is accountability throughout the process. (Tuttle, 1993: 14-15)

General Tuttle goes on to suggest that the DoD system does not currently have the ability to establish control and accountability like Federal Express. His suggestion is that by simply adding the social security number of the person who handles a package, USTRANSCOM can isolate responsibility to one person (Tuttle, 1993: 15-16).

If the ports in the theater are answerable to TRANSCOM for the accuracy of in-transit asset visibility, knowing well that losses are not tolerated--I understand that Federal Express has a very low tolerance for losses--then there is a good chance the process can work. If there is accountability down to the delivering driver and if the truck group commander (and C-130 wing commander) is part of TRANSCOM, everyone involved would have an interest in making sure that the information system knows where the sustainment cargo or the unit equipment is at any time. (Tuttle, 1993: 16)

Along with accountability, feedback is essential to establishing a workable system. When data errors are found and reported back to those who are responsible, adjustments and corrections can be made. In an effort to establish accountability and provide feedback, AMC is currently tracking C2IPS data accuracy for each of its units and giving them monthly feedback (see Appendix C). This effort requires what Colonel Bunn calls a "data cop," someone to monitor and ensure that data flowing into the system is input and handled correctly.

My number one priority for everybody in my office (AMC DOU) and in AMC is that we have to have quality data. To do this you have to track the data that is moving through the systems. We must make sure the data is right and that is manpower intensive. Until we are sure that everything works right we are going to have to have people watching the data and making sure it is correct. (Bunn, 1996: Lecture)

Once the data is checked and tracked in the AMC system, a message is generated that details input errors by unit. With this message each of AMC's units can better identify the source of their data inaccuracy. With this feedback, responsibility for errors is given back to the unit. In so doing, the unit is given the opportunity to correct or change procedures to improve quality.

For the GTN system to succeed, accountability and feedback are required at all levels. This principle is particularly important at the front-line unit that is collecting and inputting initial data into the system. By adopting an accountability system like that proposed by General Tuttle and a feedback system similar to AMC's, USTRANSCOM could be the single manager to control data quality.

Adequate Training. *Inadequate training* was identified as a cause factor for data inaccuracy in three of the four areas on the fishbone diagram. Almost without saying, adequate training is essential if GTN data accuracy is to be achieved. Adequate training is also the key to reducing some of the other cause factors identified in Chapter 3 of

this study. With adequate training, the effects of a *changing environment* and the confusion factors associated with the *"fog of war"* are minimized. *Lack of experience* is also quickly overcome with adequate training.

The issue of what is adequate training for all of the aspects of the GTN system is far beyond the scope of this study. Possibly, future research could address the issue of what is required for an adequate GTN training system.

Currently, computer-based training (CBT) methods are being proposed by USTRANSCOM as the main source of technical training (USTRANSCOM, 1995b: 21). One of the issues that USTRANSCOM must address from the start is the need to standardize this system across organization and service lines. Many questions must be answered in this area. For example, will CBT training be centralized at USTRANSCOM or will it be done at the individual units? Will an effort be made to standardize equipment? Will each of the units responsible for data input have the necessary equipment and expertise to implement adequate CBT? USTRANSCOM, as the single manager of GTN training, must address these and many

more issues if they are to successfully implement GTN and thus achieve ITV.

Communication Factors

Adequate communication are all about being able to get the right information to the right destination when it is needed. To do this the DoD needs a robust communication capability and network.

Vertical/Horizontal Disconnects. To effectively overcome the *vertical/horizontal disconnects* that exist in the GTN system, USTRANSCOM must give specific attention to organizational and service communication barriers. One of the key barriers is service/organizational resistance to adopt new standardized systems and procedures.

One such system is the Joint Operations and Execution System (JOPES). JOPES is essential because of its ability to provide feedback from the planning system to the DTS through GTN. This capability of JOPES must be enhanced and expanded so that clear lines of communication exist between the two systems.

Horizontally, communication links must also be established between the previously stove-piped DTS systems. With USTRANSCOM as the single manager, this task should be easier but it still could present challenges because of the diversity of the systems. For the systems that migrate to the latest version of the GTN, communications interfaces between systems must receive the highest priority.

Adequate Communications Infrastructure. The cause factor of inadequate communications infrastructure can be reduced or eliminated by investing enough in the right the right technology. With "big pipes," the amount of information transferred will no longer be a constraint. With enough communications capacity, complex transmissions and security requirements can easily be met without introducing errors into the system.

The DoD needs to ensure the availability of adequate communications capacity to support ITV requirements in peace and war. While some commercial networks could augment existing DoD capabilities, even the combination of Defense and commercial networks may be inadequate in some theaters. USTRANSCOM should determine the communications requirements of GTN and other source systems. It should then work with theater communications, operations, and logistics staffs to develop a strategy for prioritizing and allocating assured communications capacity. (DoD, 1995, xvi)

One of the most promising ways to establish an adequate infrastructure is through the use of satellite technology. Currently, a new system is being tested that is analogous to commercial direct-broadcast television. This system is called the Global Broadcast Service (GBS). GBS promises a high-payoff for a variety of missions (Scott, 1996: 61).

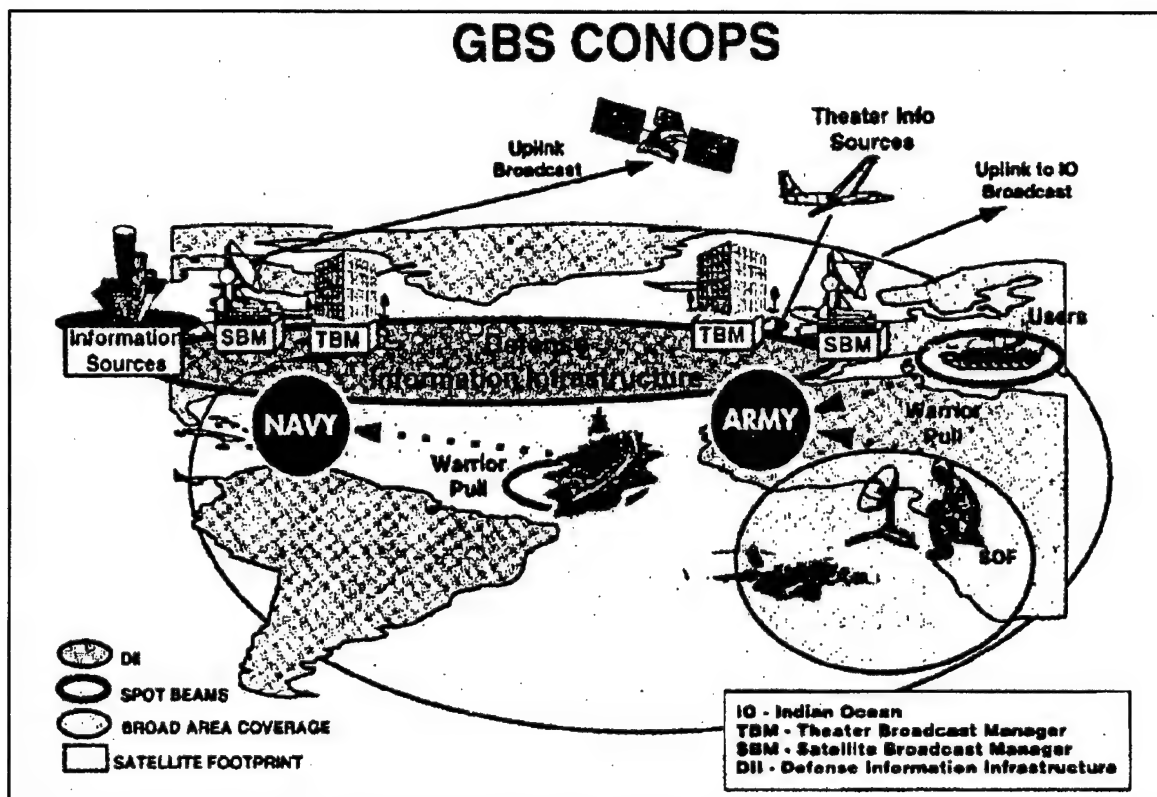


Figure 10: GBS Concept of Operations (Scott, 1996: 61).

"GBS satellites offer significant potential for getting real-time imagery, logistics files and other information to military field units" (Scott, 1996: 61). The GBS system

would supply the "big pipes" needed to make GTN work properly.

The concept is that a direct link with the field can be made from an information source either in the United States or another theater for near real-time transfer of data. The field coverage or Broad Area Coverage, as depicted in Figure 10, is approximately 200 by 200 nautical miles square. In this area of coverage, command and control personnel like a supervisor of flying (SOF) can down-link and up-link near real-time large files such as video and graphics imagery. Spot beams can also be directed to specific users in other areas. The field link is established on a 22 inch portable satellite dish that is similar to the 18 inch dishes now used in commercial systems (Scott, 1996: 61). This type of technology would, in essence, remove the data flow constraints from GTN and would thus promote data accuracy.

This type of infrastructure is essential to the success of GTN. To make ITV a reality the DoD must invest in a "big pipe" system like GBS. Satellite technology promises to be the platform of choice and the means to reduce data inaccuracy in the GTN system.

Data Standardization Factors

Operating Policies. In an effort to overcome the diversity in operating policies over the various systems that make up GTN, USTRANSCOM is developing a new Defense Transportation Regulation (DTR). This new regulation amalgamates, simplifies, and replaces past service and organizational standards and procedures. The challenge here is to capture all of the information needed to operate but at the same time try to simplify the regulatory requirements (DoD, 1995: 2-5).

When the new transportation regulations and procedures are developed, DoD should standardize education, training, and certification of Military Service and Defense agency transportation agents. Those agents would be accountable for the quality and timeliness of transportation data. Commercial vendor and carrier compliance with DoD regulations and procedures could be ensured by making ITV concepts a condition of all contracts. (Scott, 1996: 61)

A standardized operating policy is the foundation needed to address the cause factor of training standardization.

Training. With a standardized operating policy, standardized training becomes much easier. Some training issues were addressed earlier in this chapter. Key to the success of GTN data accuracy is ensuring that adequate

standardized training is received across organizational and service lines. To do this, USTRANSCOM should establish direct control over who is trained and how that training is accomplished. The services should not be left to determine training standards. USTRANSCOM should implement a monitoring and feedback system for GTN and its components. Further research in this area could determine how this system should be implemented. With adequate standard training, data inaccuracy should be reduced, thus improving ITV capability.

Data Protocol. Data accuracy can be promoted by a standardized input protocol. Systems designers need to build systems that will not accept bad data. One way to do this is to develop a system with a comprehensive standardized pick list of options for data input. This not only makes the human interface with the computer easier but it also guards against allowing data input that does not comply the data protocol of the overall system. This option requires that some software be rewritten but for the system to function properly, some software changes are inevitable

anyway. The key is to establish an overall data protocol that must be complied with to interface with the system.

Electronic Transmission Standards. Within the CONUS, commercial EDI standards are well established and are being incorporated in the GTN system. For stateside cargo, the ASC X12 EDI standard will work to standardize DoD electronic transmissions. The question remains, what about overseas transactions? Obviously the DoD operates and will continue to operate outside the continental United States (OCONUS) (DoD, 1995: 2-5).

DoD recognizes that the Electronic Data Interchange for Administration, Commerce, and Transport (EDIFACT) standards will be the long-term solution for EDI transmissions, particularly in OCONUS. At this time, however, implementing EDIFACT before the American National Standard Institute (ANSI) completes its EDIFACT migration strategy would seriously delay several active Defense EDI programs and therefore ITV. DoD will eventually migrate its EDI programs to EDIFACT when the migration strategy is developed. (DoD, 1995: 2-6)

The United States is currently the largest commercial user of EDI and thus has the greatest influence on the market. Overseas markets are growing quickly and the fact remains that the DoD must operate worldwide. EDIFACT is the current standard outside the United States while ASC X12 is

the standard within. The main challenge USTRANSCOM faces in electronic transmission standardization is the fact that the worldwide commercial industry and the United States have not totally agreed on what standard they both can accept.

V. Conclusion

Desert Shield/Storm demonstrated clearly that ITV of DoD assets is an essential element of the efficient and effective use of military power. As such, ITV has become a major goal of the DoD. The GTN system being developed by USTRANSCOM is the DoD's means by which the goal of ITV is to be achieved.

A major constraint of the GTN system is obtaining accurate data. Without accurate data, the system will not be able to provide ITV and thus will not provide the information necessary for decision makers to effectively manage their assets in time of peace or war. This study sought to develop a basic understanding of the components that feed data to the GTN system, to identify some of the major causes for data inaccuracy in that system, and to propose possible solutions in an effort to minimize data inaccuracy. The research results are summarized in Table 1 and briefly discussed in the following paragraphs.

Table 1 : Research Summary.

Potential Causes	Proposed Solutions
Intentional Human Errors	
• Integrity/Discipline	• Accountability and Feedback
• Lack of Feedback	• Accountability and Feedback
• Motivation/Morale	• Easier Input (Bar Coding/RFID Tagging)
• Lack of Time	• Easier Input (Bar Coding/RFID Tagging)
• Input Difficulty	• Easier Input (Bar Coding/RFID Tagging)
• Inadequate Training	• Adequate Training Managed by USTRANSCOM
• Job/Political Pressure	• Easier Input (Bar Coding/RFID Tagging)
Unintentional Human Errors	
• Ergonomic Factors	• Easier Input (Bar Coding/RFID Tagging)
• Inadequate Training	• Adequate Training Managed by USTRANSCOM
• Lack of Experience	• Adequate Training Managed by USTRANSCOM
• Changing Environment	• Adequate Training Managed by USTRANSCOM
• Confusion/Fog of War	• Adequate Training Managed by USTRANSCOM
• Lack of Attention to Detail	• Accountability and Feedback
Communications Errors	
• Vertical and Horizontal Disconnect	• Overcome Communication Barriers/Use Current and Future Standardized Systems
• Lack of Infrastructure	• Invest in Infrastructure (GBS)
Data Standardization Errors	
• Lack of Overall Operating Policy	• Enforce use of Defense Transportation Regulation (DTR)
• Lack of Training Standards	• Adequate Training Managed by USTRANSCOM
• Lack of Data Protocol	• Design Standardized Protocol
• Inadequate use of Electronic Transmission Standards	• Adopt and Integrate EDIFACT

There are many factors that contribute to the accuracy of the data entering into the GTN system. The main issues identified in this study are human factors, communication factors, and standardization factors. The means by which a cause and effect relationship between these factors was demonstrated in this study was through the use of an Ishikawa diagram.

Of the three factors, human factors are the most critical for achieving accurate data input into the GTN system. Finding easier ways for front-line works to capture and input data are essential. Technology offers potential solutions in the form of bar codes and RFID tagging. In addition, accountability for data accuracy and feedback to those responsible for data input are critical to establishing and improving data accuracy. Adequate training is also key to successful data accuracy. It is the means by which initial accountability is established and the way a front-line worker is able to understand what is required by the system.

Once data is input correctly into the system, it must get past any communications barriers and be transmitted in a timely/effective manner to be useful. To do this, established systems must be used and an adequate communications infrastructure must exist. For the GTN system, proper use of JOPES and establishment of satellite communications, are essential requirements.

Finally, for all of the systems of GTN to interface effectively together, standards must be developed and

followed. These standards must apply to operating policies, training, data protocol, and electronic transmissions.

USTRANSCOM must be the single point of contact to control all of these issues if an effective system is to be established.

Appendix A

Component Commands of USTRANSCOM

AMC provides the airlift for strategic deployment and sustainment operations and for special common-user missions such as aero-medical evacuation. AMC is also responsible for operating some military aerial ports both within and outside CONUS. When strategic deployments occur, Air Force organic airlift assets may be augmented by assets from US commercial carriers either through contracts or activation of the Civil Reserve Air Fleet (CRAF) stages. Also, at the earliest practical point during large-scale sustainment operations, USTRANSCOM, the theater combatant commander, and AMC should consider establishing an air express service to link the established CONUS commercial air transportation infrastructure with the overseas theater.

MSC provides sealift for strategic deployment and sustainment operations. MSC acquires organic assets from funding provided by the Department of the Navy. MSC may be augmented from US-flag charter, assets from the Ready Reserve Force, and through charter agreements from US and foreign flag commercial carriers.

MTMC manages the surface transport of defense materiel and the CONUS air and surface transport of passengers. Transport is from the point of origin to the Sea Ports of Embarkation (SPOE) or Aerial Port of Embarkation (APOE). MTMC recommends all activities with the supported combatant commander. It recommends SPOEs, establishes booking procedures, and manages the movement of cargo onto common-user ships. MTMC operates common-user CONUS ocean terminals and some Sea Ports of Debarkation (SPOD) in overseas

theaters. MTMC can operate ports during contingencies, if contracts or HNS provide the labor needed to load and unload the ships. MTMC can work with the combatant commander to create water terminal operations force packages to operate SPODs where insufficient infrastructure or unreliable stevedoring labor would preclude the use of HNS. (DoD, 1994: II-5)

Appendix B

Present and Future Interfaces of GTN

System	Direction of Interface	Data Exchanged
Current Interfaces/Intransit Visibility (ITV)		
DASS	To GTN	MILSTRIP/MILSTAMP Order and Status Transactions
CAPS II	To GTN	Aircraft Cargo Manifests and Cargo Status
HOST	To GTN	Aircraft Cargo Data (Contingencies)
PRAMS	To GTN	Passenger Manifest Data and Commercial Itinerary Information
GDSS (Unclassified)	To GTN	Airlift Mission Schedules, Aircraft Arrival/Departure Times, Aircraft Status, Advisory Notices, and Summary Passenger/Cargo Information
DASPS-E/WPS	To GTN	Cargo Arriving, Departing, and On-Hand at OCONUS Water Ports
TERMS/WPS	To GTN	Cargo Arriving, Departing, and On-Hand at CONUS Water Ports
METS II/IBS	To GTN	Surface Cargo Booked for Ocean Shipment and Schedules for Ships Moving Military Cargo
Future Interfaces / Intransit Visibility (ITV)		
DAAS	From GTN	Shipment Status
DTTS	To GTN	CONUS Truck Shipment of AA&E
GDSS (Add Classified Capability)	To GTN	Airlift Mission Schedules, Aircraft Arrival/Departure Times, Aircraft Status, Advisory Notice, and Summary Passenger/Cargo Information
IC3 (Both Classified and Unclassified)	To GTN	Ship Schedules/Movements and Ship/Port Characteristics
WPS Central Database	To GTN	Worldwide Data from WPS and IBS Systems
CFM	To GTN	Cargo Bookings, Schedules, and Movements on Commercial Land Carriers
GCCS	From GTN	ITV Data

JOPES	To GTN From GTN	Reference File Updates Status of Movement of Forces and Sustainment Required by TPFDD
STACCS	To GTN From GTN	Information on Forces Departing EUCOM Unit/Non-Unit Movements Data, including Data on Carriers
DAMMS-R	To GTN From GTN	Units/Materiel Departing Theater Carriers, Bookings, Departures, Itineraries, Schedules, and Cargo/Passenger Manifest
ATCCS	From GTN	Departures, Itineraries, and Schedules for Aircraft Moving Cargo to/from ALCs
USSTRATCOM	From GTN	Status of Aerial Refueling Tanker Assets and USSTRATCOM Cargo
TC-AIMS	To GTN	Shipments Outside Normal MILSTAMP Channels
USTRANSCOM COOP SITE	To GTN From GTN	Supports Continuity of GTN ITV
System	Direction of Interface	Data Exchanged
Current Operations		
IDHS	To GTN	Transportation Infrastructure
GCCS	From GTN	Current Operations Data
CDSS	From GTN	Decision Support Data
USTRANSCOM COOP SITE	To GTN From GTN	Supports Continuity of GTN Future Operations
Future Operations		
JOPES	To GTN From GTN	TPFDDs Updated TPFDDs
GCCS	From GTN	Future Operations Data
USTRANSCOM COOP SITE	To GTN From GTN	Supports Continuity of GTN Future Operations
Patient Movement		
CHCS	To GTN From GTN	Patient Movements Aircraft Movements
TAMMIS	To GTN From GTN	Patient Movements Aircraft Movements
DHCP	To GTN From GTN	Patient Data/Bed Availability Patient Data Request
USTRANSCOM COOP SITE		Supports Continuity of Patient Movement

(DISA Vol. 1, 1995: 11).

Appendix C

AMC Monthly Feedback Message and Data (Baer, 1996)

:UNCLAS

SUBJECT: AMC C2 SYSTEMS METRICS FOR AUGUST

1. THE C2 METRIC MESSAGE BREAKS OUT THE REJECT MESSAGES FROM GDSS TO C2IPS. THIS VERSION LAYS OUT YOUR UNITS' PROGRESS OVER THE MONTH OF AUGUST 1996. WE NEED YOUR HELP TO CONTINUE IMPROVING THE TIMELINESS AND ACCURACY OF THE C2 INFORMATION FLOW. PLEASE ENSURE WIDEST DISSEMINATION.

A. WE APPRECIATE YOUR EFFORTS IN REDUCING OPERATOR INPUT ERRORS AND SOLICIT YOUR CONTINUED PERSONAL ATTENTION TO THIS MATTER. WE ARE MAKING GREAT PROGRESS TOWARD OUR COMMAND STANDARD OF 2% ERROR.

B. CONGRATULATIONS TO THE TOP THREE ACTIVE UNITS FOR AUGUST: 628SS, 635SS, 62AW. TOP THREE RESERVE/GUARD UNITS FOR AUGUST: 445AW, 141ARW, 101ARW. ADDITIONAL RECOGNITION TO THE THREE UNITS WITH THE GREATEST REDUCTION IN REJECT PERCENTAGE: 51FW (43%), 164AW (17%), 640SS (15%).

2. THE FOLLOWING 5 AREAS ARE THIS MONTH'S TOP REASONS FOR REJECTED C2IPS MESSAGES. A BRIEF EXPLANATION IS ALSO INCLUDED EXPLAINING HOW YOUR WING CAN ELIMINATE THESE REJECTS:

A. INVALID WING/GROUP AND SQUADRON - ON THE DEPARTURE MESSAGE, THE AIRCREW WING AND SQUADRON ARE VALIDATED AGAINST VALID WING/SQUADRON/AIRCRAFT TYPES IN GDSS. THE FORMAT FOLLOWS: WINGS CONSIST OF TWO PARTS; THE UNIT NAME (I.E., 60) AND UNIT TYPE (I.E., AMW). UNIT NAME IS THE NUMERIC WING DESIGNATOR NO LEADING ZERO. UNIT TYPE IS BASED ON TYPE OF AIRCRAFT, E.G., ARW - AIR REFUELING WING, AW - AIRLIFT WING, AMW - AIR MOBILITY WING, FW - FIGHTER WING, WG - MIX OF AIRCRAFT, SW - SPACE WING, BW - BOMB WING. SQUADRON CONSISTS OF 3 NUMERIC CHARACTERS; IF THE SQUADRON NUMBER IS LESS THEN 3 CHARACTERS, BEGIN WITH ZERO. SEVERAL WINGS HAVE POSTED THE VALID ENTRIES FOR THEIR HOMESTATION WING AND SQUADRONS ON THE C2IPS TERMINAL OR YOU CAN USE THE SUPPLIED REFERENCE LISTS. THIS IS THE NUMBER ONE REASON FOR REJECTED MESSAGES BETWEEN C2IPS AND GDSS.

B. ATTEMPT TO ADD ALREADY REPORTED INFORMATION - THIS OCCURS ON ARRIVAL AND DEPARTURE MESSAGES SENT TO GDSS WITH AN ("A") ACTION CODE VERSUS AN ("R") ACTION CODE. THIS IS FIXED AT ANY NODE OPERATING 2B PRIME EBF2 SOFTWARE.

C. INVALID AIRCRAFT TAIL/TYPE - ON THE DEPARTURE AND LOAD MESSAGES, THE AIRCRAFT TYPE/TAIL NUMBERS ARE CHECKED AGAINST THE VALID AIRCRAFT TABLE IN GDSS. AIRCRAFT TYPE CONSISTS OF MISSION, DESIGN, AND SERIES, E.G., C005B, KC010A, C141B, C130H. TAIL NUMBERS ARE CONSTRUCTED BY USING THE LAST NUMBER OF THE YEAR OF MANUFACTURE AND THE LAST FOUR DIGITS IN THE SERIAL NUMBER (I.E., FOR 69-12345, THE CORRECT TAIL NUMBER WOULD BE 92345).

D. INVALID ICAO - WHEN A SCHEDULE MESSAGE IS CREATED, EACH STOP IS INDICATED BY AN ICAO. THESE ICAOS MUST BE VALID IN THE GDSS DATABASE; OTHERWISE, THE SCHEDULE MESSAGE WILL BE REJECTED. TO CORRECT THIS, ENSURE NO TYPOGRAPHIC ERRORS OCCUR (I.E., KRIV VS KRIB).

E. INVALID TASKED UNIT - ON THE SCHEDULE MESSAGE, THE TASKED UNIT IS THE WING OWNING THE AIRCRAFT; IT IS CHECKED AGAINST THE VALID WINGS IN GDSS. THE FORMAT SHOULD BE AS FOLLOWS: THE NUMERIC WING DESIGNATOR NO LEADING ZERO, UNIT TYPE IS BASED ON TYPE OF AIRCRAFT ARW - AIR REFUELING WING, AW - AIRLIFT WING, AMW - AIR MOBILITY WING, FW - FIGHTER WING, WG - MIX OF AIRCRAFT, SW - SPACE WING, BW - BOMB WING.

3. THE FOLLOWING DATA IS A BREAKDOWN OF AUGUST REJECTS BY UNIT SORTED BY THE HIGHEST REJECT RATE. IF YOUR UNIT IS ABOVE A 20% REJECT RATE, PLEASE PUT YOUR TEAM'S FULL ATTENTION ON THE ISSUE.

UNIT	REJECT_RATE	REJECTS	MESSAGES SENT	REDUCTION
JUL REJECTS				
134ARW	69.00 %	187	271	35.77% 33.23 %
TAZAR	61.25 %	147	240	06.06% 55.19 %
24WG	47.83 %	11	23	41.58% 06.25 %
133AW	42.86 %	3	7	42.86%
349AMW	42.86 %	3	7	42.86% 00.00 %
314AW	41.99 %	131	312	13.85% 28.14 %
100ARW	37.69 %	173	459	10.61% 27.08 %
374AW	28.88 %	242	838	05.88% 23.00 %
621OS2	24.07 %	91	378	24.07% 00.00 %
3WG	22.73 %	55	242	-10.92% 33.65 %
51FW	22.41 %	13	58	-43.22% 65.63 %
305AMW	20.83 %	451	2165	-06.37% 27.20 %

911AW	19.61 %	10	51	13.73%	05.88 %
19ARG	18.50 %	37	200	11.09%	07.41 %
JTFOJE	18.48 %	34	184	04.80%	13.68 %
633SS	18.07 %	148	819	-09.69%	27.76 %
86AW	17.33 %	39	225	00.00%	
172AW	16.86 %	29	172	05.10%	11.76 %
186ARW	15.66 %	13	83	00.28%	15.38 %
43ARG	15.12 %	13	86	09.79%	05.33 %
161ARW	14.18 %	19	134	-00.82%	15.00 %
164AW	14.15 %	15	106	-16.96%	31.11 %
157ARW	13.60 %	34	250	-07.57%	21.17 %
375AW	13.33 %	287	2153	-05.31%	18.64 %
621SG2	12.73 %	49	385	-05.34%	18.07 %
126ARW	12.40 %	31	250	01.42%	10.98 %
623SS	12.34 %	375	3039	-05.16%	17.50 %
440AW	12.28 %	7	57	03.42%	08.86 %
629SS	11.85 %	32	270	-08.60%	20.45 %
627SS	11.81 %	77	652	02.19%	09.62 %
4404WG	11.52 %	47	408	-02.02%	13.54 %
632SS	11.45 %	57	498	01.74%	09.71 %
630SS	11.43 %	116	1015	.00.31%	11.12 %
22ARW	10.48 %	119	1136	-03.01%	13.49 %
437AW	10.09 %	197	1952	02.76%	07.33 %
625SS	09.94 %	16	161	-01.58%	11.52 %
89AW	09.76 %	66	676	00.65%	09.11 %
151ARW	09.52 %	2	21	-05.86%	15.38 %
624AMSG	09.43 %	102	1082	01.37%	08.06%
23WG	09.36 %	19	203	-06.90%	16.26 %
NORFOL	08.80 %	38	432	-01.32%	10.12 %
626SS	08.28 %	61	737	-05.82%	14.10 %
319ARW	08.22 %	49	596	-07.45%	15.67 %
640SS	08.12 %	35	431	-14.49%	22.61 %
121ARW	07.27 %	4	55	-07.95%	15.22 %
128ARW	07.23 %	18	249	-10.76%	17.99 %
436AW	07.18 %	115	1601	-03.25%	10.43 %
439AW	06.59 %	27	410	-01.85%	08.44 %
634SS	06.39 %	25	391	02.03%	04.36 %
92ARW	06.00 %	73	1217	00.47%	05.53 %
631SS	05.69 %	19	334	-03.96%	09.65 %
155ARW	05.33 %	4	75	00.12%	05.21 %
105AW	05.22 %	12	230	00.90%	04.32 %
60AMW	04.66 %	146	3132	00.33%	04.33 %
62AW	04.39 %	67	1527	-02.79%	07.18 %

459AW	04.35 %	6	138	02.46%	01.89 %
171ARW	03.97 %	17	428	-09.31%	13.28 %
927ARW	03.77 %	8	212	-13.34%	17.11 %
101ARW	03.57 %	7	196	-08.87%	12.44 %
635SS	03.32 %	26	784	-01.44%	04.76 %
141ARW	03.20 %	4	125	-05.13%	08.33 %
628SS	02.78 %	11	395	-11.79%	14.57 %
445AW	02.00 %	6	300	-06.61%	08.61 %
108ARW	00.00 %	0	1	00.00%	00.00 %
615CSC	00.00 %	0	23	00.00%	00.00 %
7CS	00.00 %	0	1	00.00%	
934AW	00.00 %	0	2	00.00%	00.00 %
117ARW	00.00 %	0	4		
621AMC	00.00 %	0	4		
TOTAL	12.11%	4275	35298		

5. UNIT COMMANDERS NEED TO EMPHASIZE THE ACCURATE ENTERING OF INFORMATION INTO OUR C2 SYSTEM. HQ AMC/DOU HAS MADE THE REJECT INFORMATION AND TECHNIQUES AVAILABLE ON THE HQ AMC/DOUO HOME PAGE. IF YOU HAVE ANY QUESTION ABOUT THE DATA, CONTACT HQ AMC/DOUO, MAJ SMELLIE, MSGT SMELLIE OR TSgt BAER AT DSN 576-3127. THE REJECT INFORMATION IS NOW AVAILABLE ON THE WORLDWIDE WEB AT THE FOLLOWING ADDRESS:
[HTTP://WWW.SAFB.AF.MIL:81/HQAMC/DIRECTORATES/AMCDO/DOU/GDSS](http://WWW.SAFB.AF.MIL:81/HQAMC/DIRECTORATES/AMCDO/DOU/GDSS).

AMC UNIT	APRIL PERCENTAGE	APRIL REJECT	APRIL MESSAGES
141ARW	83.33%	5	6
43ARG	62.61%	72	115
911AW	57.14%	4	7
934AW	50.00%	1	2
625SS	41.05%	39	95
126ARW	32.43%	24	74
92ARW	27.58%	182	660
634SS	27.53%	98	356
633SS	27.25%	263	965
164AW	27.12%	16	59
629SS	27.10%	116	428
623SS	25.02%	698	2790
628SS	24.02%	98	408
151ARW	23.94%	17	71
108ARW	23.53%	4	17
319ARW	23.48%	143	609
128ARW	22.76%	56	246
440AW	21.57%	11	51
305AMW	21.36%	367	1718
22ARW	21.23%	283	1333
133AW	20.92%	32	153
439AW	20.72%	52	251
436AW	19.20%	320	1667
631SS	18.05%	76	421
640SS	18.02%	62	344
375AW	17.94%	370	2063
627SS	17.50%	158	903
632SS	17.28%	113	654
157ARW	17.14%	24	140
101ARW	16.76%	87	519
626SS	16.57%	57	344
155ARW	15.63%	20	128
89AW	15.52%	43	277
624AMSG	15.31%	190	1241
437AW	13.31%	299	2246
445AW	13.29%	97	730
171ARW	12.54%	41	327
105AW	11.69%	27	231
62AW	10.91%	166	1522
60AMW	10.59%	306	2889
134ARW	9.50%	32	337
459AW	8.80%	11	125
635SS	8.00%	77	962
172AW	7.69%	16	208
927ARW	5.33%	8	150
19ARW	0.00%	0	0
349AMW	0.00%	0	0
630SS	0.00%	0	0
117ARW	0.00%	0	0
121ARW	0.00%	0	0
161ARW	0.00%	0	0
186ARW	0.00%	0	0
190ARW	0.00%	0	0
AMC TOTAL	17.96%	5181	28842

PACAF UNITS	APRIL PERCENTAGE	APRIL REJECT	APRIL MESSAGES
374AW	26.60%	445	1673
3WG	26.37%	24	91
51FW	0.00%	0	0
PACAF TOTAL	26.59%	469	1764
USAFE UNITS	APRIL PERCENTAGE	APRIL REJECT	APRIL MESSAGES
100ARW	17.79%	90	506
86AW	0.00%	0	0
USAFE TOTAL	17.79%	90	506
ACC UNITS	APRIL PERCENTAGE	APRIL REJECT	APRIL MESSAGES
23WG	24.92%	155	622
24WG	0.00%	0	0
314AW	18.67%	45	241
8AF	0.00%	0	0
ACC TOTAL	23.17%	200	863
DEPLOYED UNITS	APRIL PERCENTAGE	APRIL REJECT	APRIL MESSAGES
4404WG	23.06%	113	490
615CSC	20.15%	83	412
621AMC	0.00%	0	0
615OS2	0.00%	0	0
621AMSG	0.00%	0	0
621SG2	0.00%	0	0
702OS	37.55%	656	1747
JTFOJE	0.00%	0	0
TAZAR	36.31%	57	157
JTFSWA	11.46%	11	96
DEPLOYED TOTAL	31.70%	920	2902
OTHER UNITS	APRIL PERCENTAGE	APRIL REJECT	APRIL MESSAGES
NORFOL	17.00%	76	447
7CS	0.00%	0	0
OTHER TOTALS	17.00%	76	447
NON-AMC TOTALS	27.07%	1755	6482
C2IPS TOTALS	19.64%	6936	35324

AMC UNITS	MAY PERCENTAGE	MAY REJECT	MAY MESSAGES
126ARW	63.79%	111	174
133AW	51.35%	19	37
141ARW	50.00%	3	6
934AW	50.00%	10	20
108ARW	42.86%	3	7
164AW	38.10%	16	42
629SS	32.84%	111	338
157ARW	30.32%	57	188
625SS	29.00%	58	200
22ARW	28.89%	401	1388
927ARW	28.89%	52	180
623SS	27.03%	782	2893
634SS	26.33%	109	414
633SS	23.93%	241	1007
628SS	23.81%	90	378
459AW	23.33%	14	60
305AMW	23.06%	508	2203
626SS	22.58%	70	310
911AW	22.50%	18	80
89AW	22.41%	78	348
440AW	20.45%	27	132
319ARW	19.29%	93	482
631SS	19.25%	67	348
92ARW	18.90%	103	545
172AW	18.09%	36	199
375AW	17.14%	401	2339
171ARW	16.67%	56	336
627SS	16.59%	103	621
43ARG	16.17%	54	334
436AW	14.71%	246	1672
128ARW	14.64%	35	239
640SS	14.61%	64	438
439AW	13.66%	47	344
437AW	13.36%	324	2425
101ARW	12.82%	50	390
155ARW	12.18%	19	156
151ARW	11.11%	3	27
624AMSG	11.10%	148	1333
105AW	10.34%	18	174
445AW	09.58%	39	407
635SS	08.91%	98	1100
62AW	08.08%	113	1399
60AMW	07.77%	232	2985
632SS	07.22%	39	540
134ARW	07.17%	21	293
19ARW	00.00%	0	0
630SS	00.00%	0	0
117ARW	00.00%	0	0
121ARW	00.00%	0	0
161ARW	00.00%	0	0
186ARW	00.00%	0	0
190ARW	00.00%	0	0
349AMW	00.00%	0	3
AMC TOTALS	17.56%	5187	29534

PACAF UNITS	MAY PERCENTAGE	MAY REJECT	MAY MESSAGES
374AW	26.90%	477	1773
3WG	27.75%	63	227
51FW	00.00%	0	0
PACAF TOTALS	27.00%	540	2000
USAFE UNITS	MAY PERCENTAGE	MAY REJECT	MAY MESSAGES
100ARW	23.08%	87	377
86AW	00.00%	0	0
USAFE TOTALS	23.08%	87	377
ACC UNITS	MAY PERCENTAGE	MAY REJECT	MAY MESSAGES
8AF	60.92%	53	87
314AW	52.05%	355	682
23WG	23.33%	129	553
24WG	00.00%	0	7
ACC TOTALS	40.41%	537	1329
DEPLOYE D UNITS	MAY PERCENTAGE	MAY REJECT	MAY MESSAGES
702OS	42.21%	371	879
TAZAR	36.98%	71	192
4404WG	11.49%	30	261
621AMC	00.00%	0	0
615OS2	00.00%	0	0
621AMSG	00.00%	0	0
621SG2	00.00%	0	0
JTFOJE	00.00%	0	0
615CSC	00.00%	0	2
JTFSWA	00.00%	0	60
DEPLOYE D TOTALS	33.86%	472	1394
OTHER UNITS	MAY PERCENTAGE	MAY REJECT	MAY MESSAGES
NORFOL	20.83%	90	432
7CS	00.00%	0	0
OTHER TOTALS	20.83%	90	432
C2IPS TOTALS	19.71%	6913	35066

AMC UNITS	JUNE PERCENTAGE	JUNE REJECTS	JUNE MESSAGES
927ARW	65.85%	81	123
141ARW	60.00%	3	5
133AW	59.46%	22	37
164AW	50.00%	19	38
934AW	40.00%	2	5
126ARW	38.92%	65	167
305AMW	28.13%	501	1781
625SS	27.40%	77	281
633SS	27.38%	184	672
629SS	26.49%	98	370
319ARW	23.87%	111	465
623SS	22.13%	455	2056
151ARW	21.05%	8	38
157ARW	20.81%	46	221
121ARW	20.45%	9	44
634SS	20.41%	70	343
92ARW	20.06%	141	703
89AW	19.72%	86	436
440AW	19.13%	22	115
459AW	18.18%	14	77
628SS	17.75%	68	383
632SS	17.37%	95	547
627SS	17.13%	110	642
128ARW	16.49%	31	188
43ARG	16.11%	24	149
640SS	14.53%	52	358
624AMSG	13.83%	165	1193
171ARW	13.54%	31	229
22ARW	13.43%	114	849
436AW	13.24%	228	1722
911AW	12.82%	10	78
375AW	12.44%	278	2234
631SS	12.33%	36	292
630SS	11.76%	24	204
101ARW	11.45%	53	463
62AW	10.53%	129	1225
437AW	10.49%	191	1821
439AW	10.34%	33	319
172AW	10.24%	17	166
635SS	10.03%	76	758
60AMW	9.81%	308	3140
155ARW	9.42%	13	138
445AW	9.40%	36	383
105AW	7.41%	18	243
626SS	7.39%	21	284
134ARW	6.76%	19	281
117ARW	0.00%	0	0
161ARW	0.00%	0	0
186ARW	0.00%	0	0
349AMW	0.00%	0	1
19ARW	0.00%	0	5
108ARW	0.00%	0	11
190ARW	0.00%	0	14
AMC TOTALS	15.95%	4194	26297

PACAF UNITS	JUNE PERCENTAGE	JUNE REJECTS	JUNE MESSAGES
51FW	76.00%	19	25
3WG	39.02%	144	369
374AW	35.87%	500	1394
PACAF TOTALS	37.08%	663	1788
USAFE UNITS	JUNE PERCENTAGE	JUNE REJECTS	JUNE MESSAGES
100ARW	24.70%	104	421
86AW	0.00%	0	0
USAFE TOTALS	24.70%	104	421
ACC UNITS	JUNE PERCENTAGE	JUNE REJECTS	JUNE MESSAGES
314AW	19.58%	56	286
23WG	16.98%	54	318
8AF	0.00%	0	0
24WG	0.00%	0	2
ACC TOTALS	18.15%	110	606
DEPLOYED UNITS	JUNE PERCENTAGE	JUNE REJECTS	JUNE MESSAGES
TAZAR	47.28%	113	239
621SG2	25.66%	88	343
615OS2	25.59%	119	465
JTFOJE	17.92%	50	279
702OS	17.46%	11	63
4404WG	15.72%	122	776
621AMSG	3.70%	5	135
JTFSWA	3.43%	7	204
621AMC	0.00%	0	0
615CSC	0.00%	0	1
DEPLOYED TOTALS	20.56%	515	2505
OTHER UNITS	JUNE PERCENTAGE	JUNE REJECTS	JUNE MESSAGES
NORFOL	24.69%	100	405
7CS	0.00%	0	0
OTHER TOTALS	24.69%	100	405
C2IPS TOTALS	17.76%	5686	32022

Appendix D

Acronym List

AAFES	Army/Air Force Exchange Service
ADANS	AMC Deployment Analysis System
AFDD	Air Force Doctrine Document
AFMC	Air Force Material Command
AIT	Automatic Identification Technology
ALM	Air Load Module
AMC	Air Mobility Command
AMMP	Air Mobility Master Plan
AMS	Asset Management System
ANSI	American National Standards Institute
APOD	Aerial Port of Debarkation
APOE	Aerial Port of Embarkation
ASC	American Standards Code
ASC II	American Standards Code II
ATCMD	Advanced Transportation Control and Movement Document
C ²	Command and Control
C2IPS	Command and Control Information Processing System
CANTRACS	Canadian Transportation Automated Control System
CAPS II	Consolidated Aerial Port Subsystem II
CBL	Commercial Bill of Lading
CDDS	CINC Decision Support System
CFM	CONUS Freight Management
CHCS	Composite Health Care System
CIM	Corporate Information Management
CINC	Commander-in-Chief
CMOS	Cargo Movement Operations System
CONUS	Continental United States
DAAS	Defense Automated Addressing System
DAMMS-R	Department of the Army Movements Management System-Redesigned
DASP-E	Department of Army Standard Port System - Enhanced
DBOF	Defense Business Operating Fund
DFAR	Defense Federal Acquisition Regulation
DFAS-IN	Defense Finance and Accounting Service-Indianapolis
DHCP	Defense Health Care Program

DISA	Defense Information System Agency
DLA	Defense Logistics Agency
DoD	Department of Defense
DSO	Days Sales Outstanding
DTEDI	Defense Transportation Electronic Data Interchange
DTR	Defense Transportation Regulation
DTRS	Defense Transportation Payment System
DTS	Defense Transportation System
DTTS	Defense Transportation Tracking System
DUSD(L)	Deputy Under Secretary of Defense for Logistics
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange for Administration, Commerce, and Transportation
ELIST	Enhanced Logistics Intra-Theater Support Tool
FAR	Federal Acquisition Regulation
FIPS	Federal Information Processing Board Publications
GBL	Government Bill of Lading
GCCS	Global Command and Control System
GDSS	Global Decision Support System
GDSS-MLS	Global Decision Support System - Multi-level
Security	
GOPAX	Group Operational Passenger System
GSA	General Services Administration
GTN	Global Transportation Network
HQ AMC	Headquarters Air Mobility Command
HQ USAF	Headquarters United States Air Force
HOST	Headquarters On-Line System for Transportation
I2P	Standard Transportation Industry Information Processor
IBS	Integrated Booking System
IC3	Integrated Command, Control, and Communications System
ICAO	International Civil Aviation Organization
ICODES	Integrated Computerized Deployment System
IDHS	Intelligence Data Handling System
ITO	Installation Transportation Officer
ITV	In-transit Visibility
ITV MOD	In-transit Visibility Modernization
JALIS	Joint Air Logistics Information Support System
JOPES	Joint Operations Planning and Execution System

JTCC	Joint Transportation Corporate Information Management Center
MDSS II	MAGTF Deployment Support System II
METS II	Mechanized Export Traffic System
MILSTAMP	Military Standard Transportation and Movement Procedures
MIL-STD	Military Standard
MOBCON	Mobilization Control
MSC	Military Sealift Command
MTMC	Military Traffic Management Command
MTMS	Military Transportation Management System
NAOMIS	Navy Material Transportation Office Operations and Management System
NCA	National Command Authority
NDTA	National Defense Transportation Association
NSN	National Stock Number
OSA	Operational Support Aircraft
OSD	Office of the Secretary of Defense
POD	Port of Debarkation
POE	Port of Embarkation
POMCUS	Prepositioning of Materiel Configured to Unit Sets
PPTMR	Personal Property Traffic Management Regulation
PRAMS	Passenger Reservation and Manifesting System
RF	Radio Frequency
RFID	Radio Frequency Identification
SAAM	Special Assignment Airlift Mission
STACCS	Standard Theater Army Command and Control System
TAMIS	Tanker Airlift Mobility Integration System
TAV	Total Asset Visibility
TC-AIMS	Transportation Coordinator's Automated Command and Control Information System
TC-AIMS II	Transportation Coordinator's Automated Command and Control Information System II
TCC	Transportation Component Command
TCMD	Transportation Command and Movement Document
TCN	Transportation Control Number
TD-ATD	Total Distribution - Advanced Technology Demonstration
TERMS	Terminal Management System

TMO	Traffic Management Office
TO	Transportation Officer
TOPS	Transportation Operational Personal Property Standard System
TPFDD	Time-Phased Force Deployment Data
UPC	Universal product Code
UPS	United Parcel Service
USA	United States Army
USA-NG	United States Army National Guard
USAF	United States Air Force
USN	United States Navy
USTC	United States Transportation Command
USSTRATCOM	United States Strategic Command
USTRANSCOM	United States Transportation Command
WPS	Worldwide Port System

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Vita

Major David M. Young was born on July 26, 1958 in Salt Lake City, Utah. He graduated from Murray High School in 1976 and then entered Brigham Young University. He graduated with a Bachelor of Arts degree in Chemistry and received his commission on April 21, 1983. On May 26, 1983 he was married to Mary Kocherhans and shortly thereafter left for pilot training at Williams AFB, Arizona.

After graduation from Undergraduate Pilot Training he was assigned to Kadena AB, Japan, as a C-12 pilot. After three years at Kadena, he left as an examiner pilot in the C-12. From Kadena, he was assigned to Travis AFB, California, as a C-5 pilot. At Travis, he upgraded to examiner pilot in the C-5 and was selected for instructor duty at Altus AFB, Oklahoma. While at Altus, he completed a Master of Arts degree in computer resource management from Webster University. At Altus, Major Young was selected to attend the Advanced Study of Air Mobility program at Fort Dix, New Jersey.

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13. ABSTRACT (<i>Maximum 200 Words</i>) <p>Desert Shield/Storm refocused the need for the Department of Defense to develop an effective Total Asset Visibility (TAV) plan. As part of that plan, USTRANSCOM was given the responsibility for the in-transit visibility (ITV) portion. To meet the goal of ITV, USTRANSCOM has developed the Global Transportation Network (GTN).</p> <p>The GTN system is very dependent on accurate data. In the past, GTN has been plagued with inaccurate or incomplete data. The purpose of this paper is to explore, through a variety of literature sources, possible causes for data inaccuracy in the GTN system. The Ishikawa fishbone diagram is the method used to propose possible cause-effect relationships among the important factors that affect data accuracy in the GTN system. Human factors, communication factors, and data standardization factors are identified as the main emphasis of this study.</p>				
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